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Appendix

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BAY AREA
'97 CLEAN AIR PLAN
Volume III
APPENDIX F
Stationary and Mobile Source
Control Measure Descriptions



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APPENDIX F

STATIONARY AND MOBILE SOURCE CONTROL MEASURE DESCRIPTIONS

Introduction

This document contains descriptions of measures which were included in the Bay Area '91 and '94 Clean Air Plans (CAPs) which have yet to be adopted, and eleven additional measures which have been added for this Bay Area '97 Clean Air Plan. Adopted measures, listed in the '97 CAP in Table 2, have been removed from this appendix. Table 4, "1997 Clean Air Plan Stationary and Mobile Source Control Measures" lists the measures described in this appendix. This document supersedes "Bay Area 1994 Clean Air Plan -- Stationary and Mobile Source Control Measure Descriptions," dated December 21, 1994.

The '97 CAP is a revision to the '91 and '94 CAPs which included a comprehensive strategy to reduce air pollution emissions. The previous CAPs focused on measures to be implemented during the 1991 to 1994 period, the 1995 through 1997 period, the 1997 through 1999 period, and included measures to be implemented beyond the year 2000. The '97 CAP is a continuation of the comprehensive strategy established by the '91 CAP. The '97 CAP includes changes in the organization and scheduling of some of the previous CAP measures. The '97 CAP covers the period extending from CAP adoption, expected in December 1997, to the next California air quality planning update, expected in 2000. It also includes possible control activities beyond 2000.

Many measures from the 1991 and 1994 CAPs have already been adopted. Other measures, or elements of measures have been reconsidered, and still others are described for future rule development and adoption. The descriptions of the previous control measures have been modified for this update, where appropriate. Where measures, or parts of measures, have been adopted, their status is noted in italics under the title of applicable control measure descriptions. For adopted measures, the available technology, emissions estimates or costs of implementation may have been reconsidered and modified during the rule development process. Such modifications are reflected in the staff reports accompanying each adopted rule. Table 2 of Volume I of the '97 CAP contains the list of measures, and subparts of measures, that were adopted during 1991 through 1997. Table 4 of Volume I of the '97 CAP contains the list of measures to be adopted in the future.

These control measures are primarily directed at reducing the emissions of reactive organic gases (ROG) and nitrogen oxides (NO_x), which are precursors to the photochemical formation of ozone. The measures in this document are primarily stationary source ROG and NO_x control measures, which are being considered for a planning horizon extending through about the year 2007. The stationary source control measures have been divided into seven subgroups: (A) surface coating and solvent use, (B) fuels/organic liquids storage and distribution, (C) refinery and chemical plant processes, (D) combustion of fuels, (E) other industrial/commercial processes, (F) other stationary source control measures, and (G) intermittent control measures. All but one of these measures (A17) will be implemented by the Air District.

The '97 CAP also contains source category (M) mobile source measures, initiated in 1994, that would be implemented by the Air District. These mobile source measures would complement the primary mobile source control programs (i.e., the Air Resources Board's Mobile Source Control Program and the Bay Area's Transportation Control Measures, shown in Volume II, Appendix E of the CAP).

The control measures included in this document are measures considered worthy of detailed evaluation. Ideas for control measures have been taken from a number of sources, including Air District staff suggestions, suggestions from the public, and air quality plans from other ozone nonattainment areas in

California. Measures that have already been adopted by the Air District or are planned for adoption by ARB or EPA (e.g., emission standards for off-road vehicles) are not included in this appendix. Volume V, Appendix H of the CAP contains an archive of Air District-adopted control measure descriptions. These descriptions have not been revised to reflect changes made in the rule development process. Measures planned for adoption by the ARB and EPA are part of the California State Implementation Plan (SIP), available from the Air Resources Board.

The type of information compiled for each candidate control measure is described below. As control measures go through the rulemaking process, more detailed information will be developed that may differ from the information presented in these descriptions.

Background

This section describes the specific sources of emissions that would be affected by the control measure and the major types of pollutants (e.g., ROG or NO_x) that would be reduced. Where possible, the number of facilities that would be affected by the proposed measure are given.

Regulatory History

In this section, past and present regulatory controls for the affected sources are identified. Information on whether the measure is being applied or is under development elsewhere is also presented.

Emissions Subject to Control

The source category or categories affected by the control measure are identified, and the projected "uncontrolled" emissions are shown for the years 1997, 2000 and 2003. The emission reductions from implementation of already adopted control measures are reflected in these emission projections. The emission estimates given are for an average summer day in units of tons per day (TPD), unless otherwise indicated.

Proposed Method of Control

The proposed method and level of control are described in this section for each control option being considered. If specific technologies are involved, their technical feasibility is described and examples of any current applications are given. New and innovative control technologies may provide alternatives to the control technologies described in this section and are encouraged.

Emission Reductions Expected

Based on the expected level of control specified in the previous section, potential emission reductions are calculated for the years 1997, 2000 and 2003. The calculations assume the measure is fully implemented in the specified year in the absence of other control measures that would reduce emissions from the same source category, that have not been adopted by that date. In many cases, ranges of emission reductions are provided to address the uncertainty that exists in the estimates made.

It is important to note that the timing of control measure implementation will depend on the schedule established in the final 1997 Clean Air Plan to be adopted by the Air District's Board of Directors. The scheduling of control measures is based on consideration of the measure's technological feasibility, cost-effectiveness, total emission reduction potential, public acceptability, enforceability, and any other factors deemed important (e.g., other environmental impacts), as well as Air District staff resource constraints.

Costs of Control

In this section, cost estimates for implementing the control measures are provided, if available. Costs may include capital costs (the one-time expense of purchasing pollution control equipment and other hardware) and annual operating and maintenance costs. An average cost-effectiveness estimate (i.e., cost per ton of pollutant reduced) is provided for affected sources, where possible. In some cases, cost-effectiveness estimates were taken from available information (EPA or ARB reports or other District attainment plans or rule development staff reports). In other cases, cost-effectiveness was calculated based on a discounted cash flow method using inflation adjusted 1990 dollars.

Other Impacts

In this section, environmental, energy, and social impacts (positive and negative) associated with the implementation of the proposed measures are identified. Possible environmental impacts include health risks from toxic air pollutant emissions, water pollution, solid and/or hazardous waste generation, emissions of stratospheric ozone depleting substances and emissions of global warming compounds.

References

References that are directly cited or that are used to provide general background information are listed in this section.

A. SURFACE COATING AND SOLVENT USE

CM A1: IMPROVED ARCHITECTURAL COATINGS RULE

Background

This control measure would reduce ROG emissions from architectural coatings by lowering the VOC limits for some specialty coatings, and by removing the existing small container exemption. All coatings sold in containers having capacities of one liter (1.1 quart) or less are currently exempt from Rule 8-3.

Due to the small scale and intermittent nature of architectural coating operations, the installation of control equipment is not practical or cost-effective. Therefore, the regulatory focus continues to be to encourage coating reformulation to reduce the VOC content of coatings. Coating manufacturers are prohibited from manufacturing products for sale within the District which do not comply with specific VOC limits. In addition, end-users (i.e., painting contractors and the general public) are prohibited from applying coatings which do not meet the VOC limits. It is extremely difficult to enforce architectural coating requirements from an end-user standpoint. However, by imposing limits on the manufacturers and sellers, non-complying coatings are generally not available to the end-users.

The availability of low VOC architectural coatings is dependent on the type of coating and desired coating characteristics. For example, flat and non-flat waterborne house paints are widely available with VOC contents well under the existing 250 grams per liter VOC limit. In contrast, many specialty coatings (e.g., lacquers, wood preservatives) are available only in solvent-borne formulations which have much higher VOC contents.

Regulatory History

The District regulates ROG emissions from architectural coatings under Regulation 8, Rule 3, which was originally adopted in March of 1978. Rule 8-3 has been modified several times establishing increasingly more stringent VOC limits for architectural coatings. Currently, Section 302 limits the VOC content of general architectural coatings to 250 grams per liter. Section 304 contains individual VOC limits for a number of listed specialty coatings. On January 17, 1990, Section 304 was modified to include more stringent VOC limits with future effective dates in 1992 and 1994 for several of the specialty coatings. The amendments, however, have been voided by the Superior Court of California. This court action also deleted Rule 48: Industrial Maintenance (IM) Coatings, which subjected IM coatings to a 420 g/l standard in Rule 3. In 1992, a committee was convened to negotiate a national rule with EPA for architectural and IM coatings under the provisions of the Federal Advisory Committee Act. As the committee was unable to reach consensus on a national rule, EPA is required by the Clean Air Act to promulgate either a rule or a Control Techniques Guideline (CTG) for non-attainment areas.

In 1995, the EPA published a draft rule for architectural and IM coatings. In spite of the efforts of the regulatory negotiation, the draft as proposed would provide no emission reductions for the Bay Area or other areas in California with similar rules. The draft rule has been to hearing by EPA staff, but a final rule has not been promulgated.

The South Coast AQMD has adopted a control measure in their 1989 AQMP revision proposing to further reduce the VOC limits of architectural coatings and to eliminate the small container exemption (CM 88-A-8a). Although at one time, staff proposed to remove the exemption for small (< one quart) containers, as of November 8, 1996, the South Coast AQMD still exempted small containers.

Emissions Subject to Control

Inventory estimates are available for a wide variety of specific architectural coatings -- this control measure will affect only certain specialty coatings. The most notable architectural specialty coatings for which lower VOC standards are considered feasible are the clear wood finishes (i.e., lacquer, varnish, and shellac). The emissions from associated cleanup solvent categories should also be affected due to

increased use of waterborne coatings; the emissions from cleanup solvent usage were not, however, included with this control measure in order to avoid overlap with CM A18, "Substitute Solvents Used for Surface Preparation/Cleanup of Surface Coatings," which should provide more significant overall reductions in cleanup solvent emissions.

The emissions from architectural coatings sold in small containers have not been well established. Small containers were assumed to account for between 0.5 and 5 percent of the total solvent-based specialty coating emissions, depending on the coating type. The projected emissions subject to control are given below.

<i>Year</i>	<i>Emissions Subject to Control (TPD, Summer)</i>
1997	3.51 (arch) + 3.09 (IM)
2000	3.37 (arch) + 2.97 (IM)
2003	3.30 (arch) + 2.90 (IM)

Proposed Method of Control

This control measure will reduce the VOC limits for some architectural specialty coatings below the current standards. This will force coating manufacturers to continue reformulation and encourage the development of alternate technologies, such as the newly emerging reactive diluent technology. Reactive diluent coatings result in lower ROG emissions because most of the organic solvents chemically react to become part of the finished coating. Technological advancements made with flat and non-flat waterborne coatings also may be transferable to some of the specialty coating categories.

The South Coast AQMD estimated that reformulation with waterborne or low solvent technology will result in coatings with a VOC content of 300 to 400 grams per liter by the year 2000, and 150 to 300 grams per liter by the year 2010. These estimates are based on reformulation technology currently in use or under development in the architectural coating industry.

Emission Reductions Expected

In order to address uncertainty in the VOC levels that will be achievable for the coatings being considered, low and high emission reduction estimates were made. The level of control was calculated for each affected coating based on the difference between the current (or future effective) adopted VOC limit and an assumed 275 grams per liter VOC standard. The low emission reduction estimates, ranging from 21 to 50 percent depending on coating type, were made assuming that coating usage would remain constant on a volume of total coatings applied basis. The high emission reduction estimates, ranging from 32 to 75 percent depending on coating type, were made assuming that coating usage would remain constant on a volume of coating solids applied basis. Eliminating the small container exemption was assumed to result in an average reduction in ROG emissions from solvent-based specialty coatings sold in small containers of 75 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

Year	EMISSION REDUCTIONS	
	Low (TPD, Summer)	High (TPD, Summer)
1997	0.91 (arch) + 0.62 (IM)	1.26 (arch) + 0.93 (IM)
2000	0.88 (arch) + 0.59 (IM)	1.21 (arch) + 0.89 (IM)
2003	0.86 (arch) + 0.58 (IM)	1.19 (arch) + 0.87 (IM)

Costs of Control

The cost-effectiveness of this measure is unknown, because it is difficult to predict the amount of research work necessary to apply waterborne or some other technology to a specific class of coatings. The South Coast AQMD expects the costs to be minor because the proposal is not completely technology forcing, but follows the current trend in architectural coating development. A cost-effectiveness of \$2000 per ton reduced is assumed, based on cost estimates used in the past for coating reformulation.

Other Impacts

No significant adverse environmental impacts are expected as a result of this control measure. As waterborne technology in coatings increases, environmental benefits will result from the reduction in solvent waste generated in manufacturing and user cleanup. There is the possibility of an increase in emissions of stratospheric ozone depleting substances (such as 1,1,1 trichloroethane) and potentially toxic substances (such as methylene chloride) if coatings are reformulated with non-precursor ("exempt") solvents; however, due to the production phase out of 1,1,1, trichloroethane by 12/31/95, this is unlikely. The District may not, however, allow these types of solvent substitutions.

References

South Coast Air Quality Management District, Further Control of Emissions from Architectural Coatings, CM 88-A-8a.

revised, 8/21/97

CM A3: IMPROVED AEROSPACE COATINGS RULE

Part (a) Adopted February 3, 1993

Background

This control measure would reduce ROG emissions by establishing minimum transfer efficiency requirements for aerospace coating operations, and by reducing the VOC limits for some aerospace coatings.

The aerospace coating category includes the initial and rework coating of aircraft, helicopters, missiles, and related components. The coatings are applied for protection from environmental elements, drag resistance, and appearance. Rework involves the removal of the existing exterior surface coating and application of a new surface coating to assure that protection and performance characteristics are maintained. Interior component coatings are usually applied during original manufacture and remain for the life of the product. The coating process involves several steps, including surface preparation, basecoat and topcoat application, and cleanup. Organic solvent emissions result from the application and drying of the coatings and cleanup solvents for spray gun cleaning.

There are less than 10 major manufacturing and rework facilities in the District. There are probably about a hundred subcontractors within the District that at least occasionally coat aerospace components.

Regulatory History

The District regulates emissions of volatile organic compounds from aerospace coating under Regulation 8, Rule 29. Section 302 specifies the maximum VOC content for a variety of aerospace coatings. This section includes some reduced VOC limits with effective dates of January 1, 1992. Rule 8-29 currently has no provision specifying minimum transfer efficiency.

The South Coast AQMD has adopted a control measure proposing to further reduce the VOC limits of aerospace coatings and to require a minimum 65 percent transfer efficiency for all aerospace coating operations in their 1989 AQMP revision (CM 88-A-4).

Emissions Subject to Control

The affected source category is *aerospace assembly and coating*. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.28
2000	0.25
2003	0.25

Proposed Method of Control

It is proposed to require the use of transfer efficient coating application equipment. Transfer efficiency is defined as the ratio of weight or volume of coating solids adhering to the substrate to the total weight or volume of coating solids used in the process, respectively.

The majority of coatings used on aerospace components are applied by conventional air atomized spray; however, exterior plane surfaces are often done with electrostatic and roller application methods. Transfer efficiency for conventional air atomization is estimated to be in the range of 30 to 60 percent. The use of electrostatic technology in conjunction with conventional air atomized spraying procedures can achieve transfer efficiencies as high as 65 to 85 percent. This method is currently more applicable to initial coating applications. Rework application using electrostatics have shown problems relating to possible damage to on-board electronic components and fear of ignition of fumes in fuel tanks. In such cases, alternate technologies such as high volume, low pressure (HVLP) spray would be able to meet transfer efficiency requirements.

Aerospace coating manufacturers have developed successful phosphate-ester resistant primers with VOC contents of 350 grams per liter, the existing standard. A number of topcoats with VOC contents of 420 grams per liter have been developed, representing a significant reduction from the previous standard of 600 grams per liter. Continued reformulation efforts should provide a wider range of low VOC coatings capable of meeting Federal Aviation Administration and Military Specification Standards. In particular, it is believed that lower VOC levels will be achievable for adhesive bonding primers, fuel tank coatings and sealant bonding primers.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. Establishing a minimum transfer efficiency requirement was assumed to reduce aerospace coating emissions by 20 to 30 percent. An additional 5 percent reduction in emissions from coatings usage was estimated for lowering the VOC limits for selected coatings.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
Year	Low (TPD, Summer)	High (TPD, Summer)
1997	0.07	0.10
2000	0.06	0.09
2003	0.06	0.09

Costs of Control

Implementation of transfer efficiency requirements will likely result in the modification of existing, or the purchase of new spray equipment. Conventional air atomized sprayers will be replaced by alternate spray guns or an electrostatic system, or ideally, a combination of both. New equipment costs are expected to be offset by a savings in paint consumption. The South Coast AQMD has estimated the range of cost associated with meeting a transfer efficiency requirement to be a savings of \$6 to \$22 per ton reduced due to an overall reduction in paint usage.

The costs of reformulation are unknown because it is not possible to predict the amount of research work necessary to develop lower VOC coatings. A cost-effectiveness of \$2000 per ton reduced is assumed, based on cost estimates used in the past for coating reformulation.

Other Impacts

Transfer efficiency is a measure of coating waste. A higher transfer efficiency will result in less coating used per application and, therefore, less coating waste.

As waterborne technology in coatings increases, environmental benefits will result from the reduction in solvent waste generated in manufacturing and user cleanup. There is the possibility of an increase in emissions of stratospheric ozone depleting substances (such as 1,1,1 trichloroethane) and potentially toxic substances (such as methylene chloride) if coatings are reformulated with non-precursor ("exempt") solvents. The District may not, however, allow these types of solvent substitutions.

References

Department of Health Services, State of California, 1986. Guide to Solvent Waste Reduction Alternatives. Alternative Technology and Policy Development Section, Toxic Substances Control Division. 1986.

South Coast Air Quality Management District, Staff Report, Proposed Amended Rule 1124, Aerospace Assembly and Component Coating Operations, February 14, 1990.

revised, 8/21/97

CM A5: IMPROVED SURFACE COATING OF MISCELLANEOUS METAL PARTS AND PRODUCTS RULE

Part (a) Adopted February 3, 1993

Background

This control measure would reduce ROG emissions by adding a transfer efficiency requirement, and by lowering VOC limits where feasible, for miscellaneous metal parts and products coatings.

A large variety of metal parts are coated both to prevent corrosion and to enhance appearance. Metal parts and products include, but are not limited to, farm machinery, small appliances, industrial machinery, and fabricated metal components. The coatings are applied either as part of the original equipment manufacturing (OEM) process or by special coating applicators (commonly called "job shops") whose sole business is the coating of a variety of parts. Before a coating is applied, parts are cleaned to remove grease, dust, or corrosion. Typical coating application methods include conventional spray, airless spray, electrostatic spray, flow coating, dipping, electrodeposition, and powder coating.

Spraying is the most common application method of applying primers, single coats, and topcoats. It provides a transfer efficiency typically ranging from 20 to 70 percent. For flow coating, metal parts are moved by conveyor through an enclosed booth. Inside, a series of nozzles shoot streams of coating, which "flow" over the part. Dip coating involves manual or automated immersion of the parts into a tank of coating. Both the flow and dip methods achieve transfer efficiencies in excess of 90 percent. In electrodeposition, parts are grounded and immersed in a bath of coating. Electrical potential causes the solids in the coating to adhere to the substrate. Powder coating is applied to parts by spraying. There is virtually no solvent in powder coatings. The parts are then moved to an oven where the paint particles melt and then flow over the part forming a continuous film.

Organic emissions from the coating of metal parts occur from the application, flashoff (prior to entering an oven), and drying processes. Generally, large industrial parts are air dried because of their size or because they contain heat sensitive materials. Small parts and assembly line types of parts are more likely to be force dried in ovens.

The number of facilities within the District that are subject to this control measure probably exceeds several hundred.

Regulatory History

The District regulates precursor organic emissions from metal parts coating under Regulation 8, Rule 19. Section 302 specifies the maximum VOC contents allowable for baked and air dried coatings. Baked coatings are defined as being dried at a temperature above 194°F. In addition to the general limits, Section 312 provides alternate limits for "specialty coatings" that are not readily available in low solvent formulations.

Currently, there is no transfer efficiency requirement in Rule 8-19. The District has considered adopting a transfer efficiency requirement in the past, but has elected not to do so in part because there was no reliable way to test for transfer efficiency. The South Coast AQMD, however, currently has a transfer efficiency requirement for metal parts coatings.

Emissions Subject to Control

The affected source category is *miscellaneous metal parts and small appliance coating*. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	1.89
2000	1.98
2003	2.06

Proposed Method of Control

The use of transfer efficient equipment is proposed for metal parts coating operations. Transfer efficiency is defined as the ratio of the weight or volume of coating solids adhering to the substrate to the total weight or volume of coating solids used in the process.

Conventional air atomized spraying is the most wide-spread coating application method in the metal parts industry, achieving transfer efficiencies ranging from 30 to 60 percent. In recent years, a shift to more transfer efficient spraying techniques including airless, air assisted airless, electrostatic, and high volume, low pressure (HVLP) spraying has begun. There are a number of combinations of the above techniques (most of which involve electrostatics) which would achieve transfer efficiencies estimated to be in the range of 65 to 85 percent.

A minimum transfer efficiency standard in the metal parts rule would require most applicators to modify or replace their current spraying equipment with one or more of the spraying techniques discussed above.

Reformulation, rather than add-on controls, has been the means by which the metal parts coating industry has complied with current VOC limits for general coatings. However, there are still a number of "specialty coatings" with relatively high VOC content. Without more stringent limits, there is no incentive to reduce emissions from these coatings. Continued reformulation efforts should be able to provide low solvent substitute formulations for at least some of the specialty coatings.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. Establishing a minimum transfer efficiency requirement was assumed to reduce ROG emissions from coatings usage by 25 to 35 percent. An additional 5 percent reduction in emissions was estimated for lowering the VOC limits for selected specialty coatings.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	0.57	0.76
2000	0.59	0.79
2003	0.62	0.82

Costs of Control

Transfer efficiency requirements will result in the modification or replacement of conventional spray equipment. New equipment costs should be completely offset by a savings in paint consumption.

The cost of reformulation is not known because it is not possible to predict the amount of research necessary for a given coating category. It is likely that the cost per gallon of coatings will increase, but that this increase will be somewhat offset by a reduction in the volume of coating required, due to higher solids content. A cost-effectiveness of \$2000 per ton reduced is assumed, based on cost estimates used in the past for coating reformulation.

Other Impacts

Transfer efficiency is a measure of coating waste. A higher transfer efficiency will result in less coating used per application and, therefore, less coating waste.

As waterborne technology in coatings increases, environmental benefits will result from the reduction in solvent waste generated in manufacturing and user cleanup. There is the possibility of an increase in emissions of stratospheric ozone depleting substances (such as 1,1,1 trichloroethane) and potentially toxic substances (such as methylene chloride) if coatings are reformulated with non-precursor ("exempt") solvents. The District may not, however, allow these types of solvent substitutions.

References

Department of Health Services, State of California, 1986, Guide to Waste Reduction Alternatives, Alternate Technology and Policy Development Section, Toxic Substances Control Division.

revised, 8/21/97

CM A6: IMPROVED SURFACE COATING OF PLASTIC PARTS AND PRODUCTS RULE

Part (a) Adopted February 3, 1993

Background

This control measure would reduce ROG emissions by adding a transfer efficiency requirement, and by lowering VOC limits where feasible, for plastic parts and products coatings.

Plastic products include signs, computer and machinery housings, small appliances, and fixtures. Plastic products can be sprayed, flow coated, or dip coated. The particular application method depends on the product and its end use. Most single coating operations use spraying. Two-coat systems usually employ dip coating of the primer and spraying of the topcoat.

Emissions result from the application and drying of the coating, with most of the emissions occurring from the spray booth and the flashoff area. Due to the low melting point of plastics, most plastic parts are air dried rather than baked.

There are approximately fifty facilities in the District that would be affected by this control measure.

Regulatory History

The District regulates precursor organic emissions from plastic parts coating under Regulation 8, Rule 31, which was adopted in 1983. Section 302 contains a general VOC limit of 340 grams per liter of coating applied. In addition to the general limits, Sections 306 and 309 provide alternate limits for flexible coatings and "specialty coatings" that are not readily available in low solvent formulations.

Currently, there is no transfer efficiency requirement in Rule 8-31. The District has considered adopting a transfer efficiency requirement in the past, but has elected not to do so in part because there was no reliable way to test for transfer efficiency.

Emissions Subject to Control

The affected source category is *plastic parts and products coating*. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.80
2000	0.89
2003	0.97

Proposed Method of Control

The use of transfer efficient equipment is proposed for plastic parts coating operations. Transfer efficiency is defined as the ratio of the weight or volume of coating solids adhering to the substrate to the total weight or volume of coating solids used in the process.

Conventional air atomized spraying is the most widespread coating application method in the plastic parts industry, achieving transfer efficiencies ranging from 30 to 60 percent. In recent years, a shift to more transfer efficient spraying techniques including airless, air assisted airless, and high volume, low pressure (HVLP) spraying has begun. There are a number of combinations of the above techniques which would achieve transfer efficiencies estimated to be in the range of 65 to 85 percent.

A minimum transfer efficiency standard in the plastic parts rule would require most applicators to modify or replace their current spraying equipment with one or more of the spraying techniques discussed above.

Reformulation, rather than add-on controls, has been the means by which the plastic parts coating industry has complied with current VOC limits for general coatings. However, the flexible coatings and specialty coatings still have relatively high VOC content. Without more stringent limits, there is no incentive to reduce emissions from these coatings. Continued reformulation efforts should be able to provide low solvent substitute formulations for at least some of these types of plastic coatings.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. Establishing a minimum transfer efficiency requirement was assumed to reduce ROG emissions from coatings usage by 25 to 35 percent. An additional 5 percent reduction in emissions was estimated for lowering the VOC limits for selected specialty coatings.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	0.24	0.32
2000	0.27	0.36
2003	0.29	0.39

Costs of Control

Transfer efficiency requirements will result in the modification or replacement of conventional spray equipment. New equipment costs should be completely offset by a savings in paint consumption.

The cost of reformulation is not known because it is not possible to predict the amount of research necessary for a given coating category. It is likely that the cost per gallon of coatings will increase, but that this increase will be somewhat offset by a reduction in the volume of coating required, due to higher solids content. A cost-effectiveness of \$2000 per ton reduced is assumed, based on cost estimates used in the past for coating reformulation.

Other Impacts

Transfer efficiency is a measure of coating waste. A higher transfer efficiency will result in less coating used per application and, therefore, less coating waste.

As waterborne technology in coatings increases, environmental benefits will result from the reduction in solvent waste generated in manufacturing and user cleanup. There is the possibility of an increase in emissions of stratospheric ozone depleting substances (such as 1,1,1 trichloroethane) and potentially toxic substances (such as methylene chloride) if coatings are reformulated with non-precursor ("exempt") solvents. The District may not, however, allow these types of solvent substitutions.

References

Department of Health Services, State of California, 1986, Guide to Waste Reduction Alternatives, Alternate Technology and Policy Development Section, Toxic Substances Control Division.

revised, 8/21/97

CM A7: IMPROVED CAN AND COIL COATING RULE

Background

This control measure would reduce ROG emissions from metal container and coil coating by lowering the allowable VOC limits for some coatings.

Surface coatings are applied to metal containers, cylinders, pails, and drums to serve as liners and sealers, and to provide a protective and decorative finish. In coil coating, flat metal sheets that come in coils are typically roll coated on a production line basis. These metal coils are then formed or shaped into a variety of finished products such as gutters, siding, shelving, cans and many other items.

Organic emissions from can and coil coating operations occur in the coating application and flashoff areas, and in the baking ovens. The majority of the emissions occur before the coated metal coils or cans enter the ovens.

The District has 19 can plants, 5 drum and barrel plants, 2 crown and closure plants, and 14 miscellaneous fabricated metal plants. At least 2 of the 14 miscellaneous fabricated metal plants produce coated steel strapping. These totals are not cumulative as some plants fall into two categories.

Regulatory History

The District regulates precursor organic emissions from metal container, closure and coil coating under Regulation 8, Rule 11. Rule 8-11 was based on a Control Techniques Guideline (CTG) issued by EPA, which established VOC limits for the various types of coatings used in the industry. Rule 8-11 contains a provision for the use of non-complying coatings if equivalent emission reductions are achieved through the use of an approved control device, which is typically an incinerator. The Rule has been modified several times, most recently in 1989 when the allowable VOC content of some coatings were reduced, and abatement device requirements were made more stringent.

Emissions Subject to Control

The affected source category is *can and coil coatings*. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	4.57
2000	4.99
2003	5.37

Proposed Method of Control

Coating technologies such as radiation curable, powder systems, water-borne, and high solids have the potential for further reducing VOC emissions from some can and coil coating operations. Radiation curable coatings are high solids formulations which contain little or no organic solvents. These coatings use ultraviolet or electron beam energy to initiate the reaction to form a polymer surface coating. Radiation curable coatings, because of their high viscosity and need for control of coating thickness, are most amenable to flat stock roll coatings applications. Improvements in engineering have also allowed

the application of radiation curable coatings on a three dimensional basis. Ultraviolet curable (UV) coatings systems are currently used by several companies in the District including Tri Valley and Beatrice/Hunt Wesson (Pacific Rim, which recently discontinued its local operation, also had a UV curable line).

Powder coatings may also represent an acceptable alternative to conventional, organic solvent based coating systems in certain applications. Powder coatings, applied as a powder and then baked in an oven to form a surface coating, are nearly 100 percent solids by weight. Myers Container Corporation uses a powder coating on the interior of some food product drums. Suitable powder coating systems may be able to be developed for other can and coil coating applications.

Some water-borne and high solids coatings that have VOC levels below existing standards may be suitable for certain can and coil coating applications. For example, an end sealing compound (Darex) is currently available with no VOCs. The use of this specific product could be encouraged by lowering the allowable VOC content for end sealing compounds. Because this product may not be suitable for all applications, a separate end sealing compound category for compatible products could be established.

Cleanup solvent usage is another area where further emission reductions may be possible in the can and coil coating industry. Solvents have been formulated that are citrus based, and other low VOC solvents have been formulated that are a mix of organic solvents plus water. These solvents are apparently quite suitable for wipe cleaning, which constitutes a major use of solvents in the can and coil coating industry. The feasibility of using low-VOC/low-vapor pressure surface preparation and cleanup solvents for all types of surface coating is being considered in a separate control measure.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. This control measure was assumed to reduce ROG emissions from can and coil coatings usage by 5 to 10 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year. The actual implementation schedule will be established in the final Clean Air Plan to be adopted by the District's Board of Directors.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	0.23	0.46
2000	0.25	0.50
2003	0.27	0.54

Costs of Control

According to EPA, the applied cost of radiation curable coatings is only slightly higher than for conventional solvent coatings, for the same area of coverage. If the operating costs associated with abatement equipment for conventional coating systems are considered, a cost differential in favor of radiation curable materials may actually result. According to EPA, the applied cost of powder coating is less than the applied cost of conventional coatings. The costs of developing waterborne and high solids coatings with VOC levels below existing standards are difficult to estimate. Overall, it is believed that lowering the VOC limits for can and coil coatings will have a cost-effectiveness well within \$2000 per ton reduced, which has been used in the past for coating reformulation.

It is believed that further reductions in emissions from existing abated sources should be relatively cost-effective. Inexpensive sheet metal additions could help improve capture efficiency without increasing

the size of the abatement device. The cost-effectiveness of requiring continuous monitors on abatement devices is unknown at this time.

Other Impacts

Radiation curable coating systems use 75 to 90 percent less energy than conventional thermal curing systems. Available data indicate that some monomer emissions would be present in the exhaust for processes using radiation curable coatings, although further study is needed to better define potential toxic air contaminant problems. Particulate emissions from powder coatings are effectively controlled by fabric filtration.

As waterborne technology in coatings increases, environmental benefits will result from the reduction in solvent waste generated in manufacturing and user cleanup. There is the possibility of an increase in emissions of stratospheric ozone depleting substances (such as 1,1,1 trichloroethane) and potentially toxic substances (such as methylene chloride) if coatings are reformulated with non-precursor ("exempt") solvents. The District may not, however, allow these types of solvent substitutions.

In some cases, additional control of VOC emissions by incinerators may be needed as a result of this control measure, possibly leading to an increase in natural gas consumption. The use of thermal or catalytic incineration to control ROG emissions, may result in emissions of CO, NO_x or other criteria air pollutants. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of organic compounds and the use of natural gas in the thermal oxidation abatement devices.

References

Powder Coatings Technology Update, EPA 450/2-89-33.

Draft Evaluation of Radiation Curable Coatings as a Technology for Reducing VOC Emissions from Surface Coating Operations, EPA Control Technology Center, January 1991.

revised, 8/21/97

CM A8: IMPROVED MAGNET WIRE COATING OPERATIONS RULE

Background

This control measure would reduce ROG emissions from magnet wire coating operations by expanding the applicability of existing requirements.

In magnet wire coating, insulation coatings such as varnish or enamel are applied to magnet wire while the wire is continuously drawn through a coating applicator. Volatile organic compound emissions from coating operations can be controlled by the use of low VOC coatings, or by the use of an emission control system which collects and abates emissions from coating, drying and curing exhaust streams.

There are currently no magnet wire coating operations operating in the District that are subject to existing source-specific requirements. The applicability of the existing rule is limited by exemptions for small users and for electrical subassemblies.

Regulatory History

The District regulates the emissions of precursor organic emissions from magnet wire coating operations under Regulation 8, Rule 26. This Rule establishes VOC limits for magnet wire coatings. The Rule also contains a provision for the use of non-complying coatings provided that an approved emission control system is used. Rule 8-26 exempts small sources with emissions less than 15 lbs/day, and also sources that coat electrical machinery and subassemblies such as motor housings, rotors, stators and armatures. The exempt sources are subject to Rule 8-4, which is generally less stringent than Rule 8-26.

Emissions Subject to Control

The affected source category is *magnet wire coating*. The emissions from *other industrial/commercial coatings* were also assumed to be affected to a minor degree. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.21
2000	0.22
2003	0.23

Proposed Method of Control

By eliminating exemptions from the magnet wire coating rule, some additional sources will be subject to the existing standards. Electrical subassemblies, such as rotors and armatures are typically coated with varnish. Reformulation to water-borne or high solids coatings is the most likely method of compliance for these sources as well as for other small sources which are currently exempt. Technological advancements made in the reformulation of other industrial coatings and architectural coatings should be transferable to magnet wire coatings. ROG emissions from these operations can also be controlled with add-on abatement devices, such as incinerators or carbon adsorption systems, if substitute low VOC coatings cannot be developed.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. This control measure was assumed to reduce ROG emissions from affected coating operations by 50 to 60 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

<u>Year</u>	EMISSION REDUCTIONS	
	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	0.10	0.13
2000	0.11	0.14
2003	0.11	0.14

Costs of Control

The costs of control would stem from the research and development of complying coatings. A cost-effectiveness of \$2000 per ton reduced was assumed, based on cost estimates used in the past for coating reformulation.

Other Impacts

No significant adverse environmental impacts are expected as a result of this control measure. As waterborne technology in coatings increases, environmental benefits will result from the reduction in solvent waste generated in manufacturing and user cleanup. There is the possibility of an increase in emissions of stratospheric ozone depleting substances (such as 1,1,1 trichloroethane) and potentially

toxic substances (such as methylene chloride) if coatings are reformulated with non-precursor ("exempt") solvents. The District may not, however, allow these types of solvent substitutions.

References

None.

revised, 8/21/97

CM A9: IMPROVED AUTOMOBILE ASSEMBLY COATING OPERATIONS RULE

Background

This control measure would reduce ROG emissions from automobile assembly plants by requiring the installation of exhaust controls on sources that do not have any substantial existing controls, and by requiring the use of lower VOC coatings where feasible.

New United Motor Manufacturing, Inc. (NUMMI) is the only automobile assembly plant located in the District. NUMMI currently operates an auto assembly line, and received an Authority to Construct for a second vehicle assembly line for light duty trucks in 1990.

The vehicle assembly process incorporates a series of surface coating applications throughout the assembly line. Coatings used include sealers, primers, undercoatings, anti-chip coatings, basecoats, clearcoats, and waxes. Coatings are applied with both manual and automated sprayers. Coating applications are generally followed by oven drying. Precursor organic emissions result from the spray booths, flashoff zones, setting zones, and ovens.

Regulatory History

The District regulates the emissions of precursor organic emissions from light and medium duty motor vehicle assembly plants under Regulation 8, Rule 13. This Rule establishes VOC limits for a variety of coatings used in the industry. The Rule also contains standards for transfer efficiency for most types of coatings. In lieu of a complying coating, a company may use an approved control device to meet the provisions of the Rule, but there are no specific requirements for coating operations to be abated.

The South Coast AQMD has adopted a control measure in their 1989 AQMP revision which proposes to further reduce emissions from automobile assembly plants by instituting controls similar to those proposed in this measure (CM 88-A-8a).

Emissions Subject to Control

The affected source category is *motor vehicle assembly plant coatings*. The emissions subject to control were adjusted to account for the fact that the new vehicle assembly line being added at NUMMI will already have BACT-level controls, and therefore should not be substantially affected by this control measure.

It is assumed that this control measure will not become effective until after the year 2000; the emission reduction estimates given here assume that the measure will become effective in the year 2001. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	4.33
2000	4.51
2003	4.70

Proposed Method of Control

Reformulation to low VOC coatings is the most cost-effective method of reducing the emissions of ROG from most surface coating operations. Although progress has been made in reformulating some types of automotive coatings, others (particularly color topcoats) continue to have relatively high VOC content. According to the South Coast AQMD, reformulation efforts are underway to develop high solids, nonmetallic color coatings for use in electrostatic spray equipment. For metallic coatings, exempt solvent formulations are being developed. Although these types of coatings are not available at this time and may not be available in the near term, lowering the existing VOC limits would encourage coating reformulation, which is believed to be the most desirable method of reducing ROG emissions.

Currently, NUMMI controls emissions from their drying ovens with thermal and catalytic incineration. Other than the ovens, there are no additional add-on controls on the coating operations in the existing assembly line. In the NSR permit application for the second assembly line, NUMMI was required to control the automatic spray areas, flashoff and setting zones of the Primer/Surfacer, Topcoat I, and Topcoat II spray booths by exhaust recirculation/concentration and then carbon adsorption. The carbon adsorption units will be desorbed and the desorbed solvent will be destroyed by an incinerator.

There are several booths and zones at the NUMMI facility that are essentially uncontrolled. It is these uncontrolled areas that are the focus of this control measure. The same technology that is discussed above could be applied to similar uncontrolled coating sources.

Cleanup solvent usage is another area where further emission reductions may be possible at the NUMMI facility. Solvents have been formulated that are citrus-based, and other low VOC solvents have been formulated that are a mix of organic solvents plus water. The feasibility of using low-VOC/low-vapor pressure surface preparation and cleanup solvents for all types of surface coating operations is being considered in CM A10, Improved General Solvent And Surface Coating Rule.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. Overall, this control measure was assumed to reduce ROG emissions from coatings usage by 20 to 30 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	0.87	1.29
2000	0.90	1.35
2003	0.94	1.41

Costs of Controls

In their review of a similar control measure, the South Coast AQMD estimates that add-on controls will cost \$19,000 per ton of organics reduced. In their recent NSR permit application, NUMMI estimated the cost-effectiveness of add-on controls for the automatic primer and topcoat zones to range from \$17,400 to \$18,740 per ton reduced. These controls were deemed cost-effective, and therefore required as BACT. NUMMI also provided cost-effectiveness calculations for a number of other booths and zones which yielded significantly higher costs. Those control measures were not required as BACT. Calculations were based upon assumptions of 15 percent fugitive emissions and 95 percent destruction efficiency.

The cost-effectiveness of developing coatings with lower VOC limits is not known. Cost-effectiveness is difficult to predict for coating reformulation because the amount of research work necessary to develop a new coating formulation is difficult to predict. The costs of coating reformulation are usually offset somewhat by a reduction in volumetric coating usage (for higher solids coatings). A cost-effectiveness of \$2000 per ton reduced is assumed, based on cost estimates used in the past for coating reformulation.

Other Impacts

There is the possibility of an increase in emissions of stratospheric ozone depleting substances (such as 1,1,1 trichloroethane) and potentially toxic substances (such as methylene chloride) if coatings are reformulated with non-precursor ("exempt") solvents. The District may not, however, allow these types of solvent substitutions.

If additional control of VOC emissions by incinerators is needed as a result of this control measure, an increase in natural gas consumption will occur. The use of thermal or catalytic incineration to control ROG emissions, may result in emissions of CO, NO_x or other criteria air pollutants. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of organic compounds and the use of natural gas in the thermal oxidation abatement devices.

Where carbon adsorption systems are used to control ROG emissions, the activated bed eventually becomes "spent" and must be reactivated or disposed of at a licensed treatment storage and disposal facility (TSDF). Disposal of spent carbon adsorption filters may negatively impact solid waste disposal sites due to increased quantities of wastes. Spent carbon needs to be replaced or regenerated every 5 to 10 years. Spent carbon that is regenerated by injecting steam through the carbon bed may result in traces of solvent in wastewater after the steam/solvent mixture has been processed. However, wastewater impacts will be insignificant if generators comply with federal, State and local regulations.

The use of a carbon adsorption system could result in emissions of NO_x and CO from the combustion of natural gas to generate steam for stripping the solvent from the carbon bed. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of natural gas to generate steam for the stripping the of the carbon beds.

References

South Coast Air Quality Management District, Further Emission Reductions from Automobile Assembly Coating, CM 88-A-5.

Bay Area Air Quality Management District, Engineering Evaluation Report, Application Number 3611, New United Motor Manufacturing, Inc.

revised, 8/21/97

CM A14: IMPROVED COATINGS AND INK MANUFACTURING RULE

Parts (b) and (c) Adopted March 18, 1992

Background

This control measure would reduce ROG emissions from coating and ink manufacturing operations by establishing more stringent requirements for vat mixing and cleaning operations, by eliminating existing exemptions, and by extending the applicability of control requirements to cover adhesives manufacturing.

Surface coatings are manufactured by mixing solid powders to suspend them in a volatile liquid media. Coatings can be categorized as being either "trade sales" or industrial use coatings. Trade sales are paints such as house paints and other products marketed to the general public, professional painters and contractors. The other major market is industrial use coatings for products finishing. These products are sold directly to the original equipment manufacturer for factory applications such as automobiles, appliances, and can coatings for the food and beverage industry.

Almost every surface coating contains a resinous or resin-forming component called the binder. The binder can be a liquid, such as a drying oil, or a resin that can be changed to a solid by chemical reaction. Sometimes, if the binder is too viscous for application, a volatile solvent (thinner) is added. The binder and the solvent are together known as the vehicle. The other component of the coating is a pigment which imparts color and opacity to the paint. Other additives which are mixed with coatings to influence their properties are called extenders.

The general resin types used for manufacturing coatings are: alkyds, cellulose, acrylics, vinyls, phenolics, epoxies, polyurethanes, silicones, amino resins and latexes. A wide variety of organic solvents are used in coatings manufacturing including: hydrocarbons such as naphtha, mineral spirits, toluene and xylene; alcohols such as methyl, ethyl and butyl alcohol; ethers such as dimethyl ether and ethylene glycol; ketones such as acetone, MEK, and MIBK; esters such as ethyl and butyl acetate and; chlorinated solvents such as tetrachlorethane.

Printing inks can be divided into the letterpress and lithographic inks commonly called oil or paste inks, and flexographic and rotogravure inks, which are referred to as solvent inks. Printing inks are usually manufactured in three steps: (1) cooking the vehicle and adding dyes, (2) grinding a pigment into the vehicle using roller mills and, (3) the flushing process, which involves replacing water in the wet pigment by an ink vehicle. Typical organic compounds used in ink manufacturing are fatty acids, glycerine, phenols, aldehydes, ketones, terpenes oil and thinning solvents.

Emissions from the coatings and ink manufacturing process mostly consist of ROG emitted from cooking, mixing and solvent cleaning operations.

There are approximately five ink and thirty coating manufacturing plants located within the District.

Regulatory History

The District regulates precursor organic emissions from coatings and ink manufacturing under Regulation 8, Rule 35. Rule 8-35 establishes control requirements for stationary vats, and for the operation and cleaning of mixing vats and grinding mills. Stationary vats which emit more than 15 lb/day must be controlled by an abatement device. For mixing operations, Rule 8-35 requires that affected equipment remain covered, except for adding ingredients or taking samples. Rule 8-35 currently exempts small manufacturers where coating/ink production is under 500 gallons per day, and equipment used for manufacturing waterbased coatings. The Rule currently does not explicitly apply to adhesives manufacturing.

Emissions Subject To Control

The affected source category is *coatings and inks manufacturing*. Only a portion of the total emissions in this category was considered to be subject to this control measure. The projected ROG emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	.49
2000	.50
2003	.51

Proposed Method Of Control

Several control options directed at further reducing ROG emissions from coatings and ink manufacturing are under consideration. Emissions from mixing operations and mills could be further reduced by collecting fugitive emissions and venting them to an abatement device such as a carbon adsorption system or an incinerator. This requirement could be specified for vats or groups of vats of a specified

size or emissions level, perhaps by lowering the existing 15 lb/day cutoff for abatement of stationary vats.

It is also proposed to extend the applicability of the existing Rule 8-35 by eliminating exemptions and by subjecting adhesives manufacturing to control requirements. These changes would reduce emissions by subjecting more sources to control requirements.

Finally, more stringent requirements for vat cleaning are proposed. Emissions from vat cleaning can be reduced substantially by using low volatility and/or low VOC cleanup solvents. Fully enclosed, automatic cabinet washing systems that use water-soluble cleaning solutions are available for washing vats and tanks.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. It was assumed that eliminating exemptions and adopting more stringent vat cleaning requirements would reduce ROG emissions from affected sources by 20 to 30 percent. Abating fugitive emissions from mixing vats was assumed to reduce ROG emissions by 60 to 80 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	0.29	0.39
2000	0.30	0.40
2003	0.31	0.41

Costs of Control

It is anticipated that abatement requirements for mixing vats will be established only for those sources with relatively significant emissions. For these sources, a typical control system is expected to have capital costs of about \$30,000 to \$150,000 and operating costs of \$15,000 to \$80,000 per year. The cost-effectiveness of these controls should not exceed \$6000 per ton of ROG reduced.

The costs for covering mixing vats range from \$500 to \$2000 depending on the size of the tanks. The cost of fitting mixing vats with covers would be recovered in solvent savings within 2 to 6 years.

The capital cost for self contained cleaning systems is estimated to be about \$18,000, with an operating cost of \$4,800 per year. The costs of the automated cleaning systems are, however, estimated to be lower than the costs for the manual cleaning methods currently in use. An overall cost savings is therefore expected.

Other Impacts

No significant adverse environmental impacts are expected to result from implementation of this control measure.

If additional control of ROG emissions by incinerators is needed as a result of this control measure, an increase in natural gas consumption will occur. The use of thermal or catalytic incineration to control ROG emissions, may result in emissions of CO, NO_x or other criteria air pollutants. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of organic compounds and the use of natural gas in the thermal oxidation abatement devices.

Where carbon adsorption systems are used to control ROG emissions, the activated bed eventually becomes "spent" and must be re-activated or disposed of at a licensed treatment storage and disposal facility (TSDF). Disposal of spent carbon adsorption filters may negatively impact solid waste disposal sites due to increased quantities of wastes. Spent carbon needs to be replaced or regenerated every 5 to 10 years. Spent carbon that is regenerated by injecting steam through the carbon bed may result in traces of solvent in wastewater after the steam/solvent mixture has been processed. However, wastewater impacts will be insignificant if generators comply with federal, State and local regulations.

The use of a carbon adsorption system could result in emissions of NO_x and CO from the combustion of natural gas to generate steam for stripping the solvent from the carbon bed. There is also the possibility of minor increases in certain of the greenhouse gases (CO_2 and NO_2) due to the combustion of natural gas to generate steam for the stripping the of the carbon beds.

A reduction in the emissions of odorous compounds may occur due to further ROG reductions.

References

U.S. Environmental Protection Agency, EPA 450/3-90-006, 1990.

The Encyclopedia of Chemistry, third edition, Hampel & Hawley.

Technical Assessment Memorandum for Coating and Ink Manufacturing, BAAQMD, December 14, 1990.

revised, 8/21/97

CM A15: IMPROVED RESIN MANUFACTURING RULE

Background

This control measure would reduce ROG emissions from resin manufacturing operations by requiring abatement of pellet extrusion and final product packaging.

Resin, which is a basic component of plastics and surface coatings, is defined as solid or semi-solid organic substances with little or no tendency to crystallize. Resins can be divided into two groups, thermoplastic and thermosetting. The thermoplastic resins do not change their physical properties upon heating, while the thermosetting resins undergo physical changes when heated.

The types of resins commonly used in the industry are: polyethylene, polyvinyl, polystyrene, polypropylene, phenolic, polyester and amino resins. Typical organic compounds used in resin manufacturing are: linseed oil, mineral spirits, MEK, MIBK, toluene, xylene, ethyl and butyl acetate, styrene, butyl cellosolve, ethylacrylate and cyclopentadiene.

Resins are generally manufactured in pressurized, jacketed, heated vessels equipped with stirring mechanisms. To prevent ROG and odor emissions, depressurization (venting) of the resin reactors is usually done through a condenser followed by a carbon adsorption system or by incineration. Fugitive ROG losses may occur in several steps of the manufacturing process, including pellet extrusion and the final product packaging.

There are approximately ten plants involved in resin manufacturing within the District. Some of these plants manufacture other products from their resins. Most existing resin manufacturing plants are currently equipped with some ROG and odor control devices.

Regulatory History

The District regulates precursor organic emissions from resin manufacturing under Regulation 8, Rule 36. Rule 8-36 requires control of emissions from resin reactors, thinning tanks and blending tanks. Facilities with ROG emissions that do not exceed 10 pounds per day from these sources are not subject to the control requirements. Fugitive emissions from pellet extrusion and final product packaging are currently not covered by Rule 8-36.

Emissions Subject to Control

The affected source category is *resins manufacturing*. The projected ROG emissions in this category are given below. This control measure would affect only a portion of the emissions within this category.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.05
2000	0.05
2003	0.05

Proposed Method of Control

This control measure would require abatement of two additional emission points in the resin manufacturing process, pellet extrusion and the final product packaging. In addition to controlling emissions from the resin manufacturing vessels, the two largest resin manufacturing plants in the District also control odor and fugitive ROG emissions (including emissions from pellet extrusion and final product packaging operations) with additional carbon adsorption units installed on the building exhaust. The resin building is kept under negative pressure by venting the inside air through a non-regenerable carbon adsorption unit which, due to the low concentrations of ROG, can perform satisfactorily for relatively long periods of time before replacement is necessary. This control measure would require similar controls for other resin manufacturing plants. As an alternative to abating the exhaust from the entire building, it may be possible to provide local ventilation and control of pellet extrusion and packaging areas.

Emission Reductions Expected

The types of abatement devices that are expected to be used for reducing ROG emissions typically have control efficiencies in excess of 90 percent. Because the individual processes that make up resin manufacturing have not yet been investigated, however, emission reduction estimates are currently not available.

Costs of Control

Most of the resin manufacturing plants in the District are already equipped with ROG control devices. The extent to which these existing devices could be used to reduce ROG emissions from pellet extrusion and final product packaging is not known. The overall cost-effectiveness of this control measure has not been determined at this time.

Other Impacts

A reduction in the emissions of odorous compounds should result. Where carbon adsorption systems are used to control ROG emissions, the activated bed eventually becomes "spent" and must be re-activated or disposed of at a licensed treatment storage and disposal facility (TSDF). Disposal of spent carbon adsorption filters may negatively impact solid waste disposal sites due to increased quantities of wastes. Spent carbon needs to be replaced or regenerated every 5 to 10 years. Spent carbon that is regenerated by injecting steam through the carbon bed may result in traces of solvent in wastewater after the steam/solvent mixture has been processed. However, wastewater impacts will be insignificant if generators comply with federal, State and local regulations.

The use of a carbon adsorption system could result in emissions of NO_x and CO from the combustion of natural gas to generate steam for stripping the solvent from the carbon bed. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of natural gas to generate steam for the stripping the of the carbon beds.

References

U.S Environmental Protection Agency, EPA-650/2-74-106, 1974.

U.S Environmental Protection Agency, AP40, 1973.

revised, 8/21/97

CM A16: IMPROVED SEMICONDUCTOR MANUFACTURING OPERATIONS RULE

Background

This control measure would reduce ROG emissions from semiconductor manufacturing facilities by requiring abatement of positive photoresist operations and cleaning operations that use coating-type application equipment.

Semiconductor manufacturing operations use organic solvents as carriers and developers for photoresist and for cleaning. The photoresist process is the means by which circuitry is added to chips. A layer of resist is applied to a silicon wafer, the wafer is exposed to a pattern of light, and either the exposed or the unexposed resist is removed or "developed." Negative photoresist is the process where the unexposed resist is removed; positive photoresist is the process where the exposed resist is removed. Negative photoresists are traditionally xylene-based; positive photoresists traditionally use cellosolves as carriers, and caustics as developers.

The other area of significant solvent usage in semiconductor manufacturing is in cleaning. Semiconductors have an intense need for cleanliness and particle control because the circuitry is so miniaturized. Very small amounts of contamination, in chemical or particulate form, will ruin chips. Therefore, these facilities use large amounts of high purity solvents and water to remove particles and chemical contamination from their work-in-process. These cleaning steps are often performed after each operation. Due to the contamination problems, pure virgin solvent is generally used. These facilities tend to leave the recycling and purification of solvent to firms who handle their waste. For this reason, these firms have a high gross usage of solvent.

Regulatory History

The District regulates the emissions of precursor organics from semiconductor manufacturing operations under Regulation 8, Rule 30, which was first adopted in 1983. Rule 8-30 requires 90 percent reduction of ROG emissions from negative photoresist operations. There are no control requirements for positive photoresist. In the original semiconductor rule, control of solvent stations was achieved with cover and freeboard requirements; there were no restrictions on reservoir size or solvent flow.

Rule 8-30 was amended on March 6, 1985. In this rule revision, the definition of semiconductor manufacture was expanded, and interim limits for solvent stations were added. Abatement devices, including scrubbers, were allowed as controls for solvent stations.

The most recent revisions to Rule 8-30 were made on November 23, 1988. The exemption for negative photoresist operations at facilities emitting less than 15 lb VOC per day was changed to an exemption for facilities that consume less than 24 gallons per month of combined negative photoresist and developer. This exemption is being interpreted as net usage (i.e. evaporation) of 24 gallons per month. Two solvent station restrictions were added: solvent flow and solvent reservoirs larger than ten gallons were not allowed. These sources are now subject to Rule 8-16, Solvent Cleaning Operations. A distinction was also made between containers and reservoirs (reservoirs are subject to freeboard requirements). Final solvent cleaning station limits which excluded scrubbers were also added.

The South Coast AQMD has a semiconductor manufacturing operations rule (SCAQMD Rule 1164) which subjects both positive and negative photoresist operations to 90 percent control of ROG emissions.

Emissions Subject to Control

The affected source category is *semiconductor manufacturing*. Only five percent of the emissions in this category are estimated to be subject to this control measure. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.03
2000	0.03
2003	0.03

Proposed Method of Control

At present, Rule 8-30 requires 90 percent abatement of ROG from negative photoresist operations. Most existing installations use incineration for controlling emissions. The photoresist is sprayed on the product, then spun off. The organic solvents have ample opportunity to evaporate because there is a large liquid-vapor interface, and because air is evacuated from this equipment to protect the workers and to keep the concentration below the lower explosive limit. The District assumes that 90 percent of the VOC in negative photoresist is volatilized during application. The solvent used in negative photoresist is often xylene or a solvent of similar volatility.

The District has not developed an emission factor for positive photoresist and is currently using the 90 percent factor developed for negative photoresist. It is believed, however, that positive photoresist applicators emit less VOC than negative photoresist because the solvents used are less volatile. The carrier in positive photoresist is cellosolve or cellosolve acetate. The developer is generally tetramethyl ammonium hydroxide, which has a very low volatility. N-methyl pyrrolidone, another low volatility solvent, is also being used as a positive photoresist developer.

A requirement for abatement of all photoresist applicators, both negative and positive, is being considered. If positive photoresist emissions are significant, these sources could be abated with the same types of add-on control devices used for negative photoresist sources. Incineration should be practical for these sources because low air volumes could be used to ventilate these sources.

This control measure is also directed at reducing the emissions from coating-type application equipment that is used for cleaning. These sources probably have solvent evaporation rates similar to photoresist application, but are currently not subject to abatement requirements. These sources could be abated in the same manner as negative photoresist applicators are. Another option would be to describe this equipment in a new category in Regulation 8-16, and require 90 percent abatement (the cold cleaner definition does not adequately describe this equipment and freeboard requirements are not an adequate control measure).

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. This control measure was assumed to reduce ROG emissions from affected sources by 80 to 90 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

Year	EMISSION REDUCTIONS	
	Low (TPD, Summer)	High (TPD, Summer)
1997	0.02	0.03
2000	0.02	0.03
2003	0.02	0.03

Costs of Control

A representative proposal for incineration of emissions from solvent stations, solvent spraying, and positive photoresist has been submitted in Application #5341 by VLSI. The capital costs for this installation were calculated to be \$2500 per ton reduced, with operating costs of about \$1500 per ton reduced. The total cost of control was roughly \$4000 per ton of ROG reduced. These costs are believed to be representative of the typical costs associated with complying with this control measure.

Other Impacts

If additional control of ROG emissions by incinerators is needed as a result of this control measure, an increase in natural gas consumption will occur. The use of thermal or catalytic incineration to control ROG emissions, may result in emissions of CO, NO_x or other criteria air pollutants. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of organic compounds and the use of natural gas in the thermal oxidation abatement devices.

References

"Emissions from Semiconductor Manufacturing in the Bay Area," Steve Hill, BAAQMD, 1987.

BAAQMD New/Modified Permit Application #5341 for VLSI.

revised, 8/21/97

CM A17: CONTROL OF EMISSIONS FROM HOUSEHOLD SOLVENT DISPOSAL

Background

This control measure would reduce ROG emissions by encouraging local agency programs for the proper disposal of ROG containing household wastes.

A variety of household products contain volatile organic compounds including consumer products such as furniture polish and pesticides, and architectural coatings such as stains and lacquers. Many of these products are improperly disposed of by household refuse collection services, leading ultimately to the release of at least a portion of the volatile organics to the atmosphere, either at transfer stations or, more predominantly, at landfills. Other household products, such as old house paints, are stored for such prolonged periods of time that their volatile components evaporate.

The ROG emissions from household products which are no longer useful can be reduced by proper handling and treatment/disposal methods which contain and recycle or destroy the organic compounds.

Regulatory History

The District does not specifically regulate ROG emissions from household products disposal. The disposal of many household products in landfills is, however, regulated through hazardous waste statutes, although compliance rates are believed to be low. Household hazardous waste disposal programs are currently in operation in much of the Bay Area. These programs which are generally sponsored by

county governments are held periodically, most often with no direct costs for residents. Privately run hazardous waste disposal operations also exist, some of which will accept certain household wastes.

Emissions Subject to Control

A number of source categories are affected including most solvent-based structures coating and cleanup categories and certain consumer products categories. It was assumed that one percent of the emissions from these categories occurs due to improper disposal. The projected ROG emissions subject to control are given below. It should be noted that there may be significant overlap between this control measure and others being proposed. The emissions subject to control given below only incorporate the effectiveness of control measures already adopted. The emissions from some of the affected source categories are expected to decrease over time due to implementation of new control measures.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.42
2000	0.43
2003	0.42

Proposed Method of Control

Two actions should reduce emissions from household solvent disposal: (1) improved product labeling regarding proper disposal methods and, (2) encouragement of additional and improved local hazardous waste disposal programs. Product manufacturers can be encouraged or required to include instructions on the correct methods for storing, sealing, transporting and ultimately disposing of products. Municipalities can be encouraged to offer more frequent, more convenient, and more publicized hazardous waste disposal "drives."

Emission Reductions Expected

It was assumed that the ROG emissions from affected sources would be reduced by 90 percent by proper methods of disposal.

The estimates below show the emission reductions achievable if the measure could be fully implemented in the corresponding year.

EMISSION REDUCTIONS	
<i>Year</i>	<i>(TPD, Summer)</i>
1997	0.39
2000	0.40
2003	0.39

Costs of Control

The cost-effectiveness of this measure has not been quantified at this time.

Other Impacts

No adverse environmental impacts are expected as a result of this control measure. The measure would reduce improper and illegal hazardous waste disposal at sanitary landfills. Positive impacts on indoor air quality may result from more timely disposal of household products that are no longer useful.

References

None.

revised, 8/21/97

CM A18: SUBSTITUTE SOLVENTS FOR SURFACE PREPARATION/CLEANUP OF SURFACE COATINGS

Background

This control measure would reduce ROG emissions by requiring the use of low VOC and/or low vapor pressure cleanup and surface preparation solvents, and by requiring improved handling procedures.

For most surface coating operations, organic solvents are used to clean and maintain application equipment, spray booths, and other materials used in the coating process. Solvents are also often used for preparing the surface of a substrate prior to coating, generally by wipe cleaning. Although the volume of solvent used for these purposes may often be small in comparison with the amount of solvent used in the coating process, emissions from cleanup operations are collectively quite significant.

Regulatory History

The District regulates emissions from cleanup solvents under Regulation 8, Rules 1, 4, and 16. Sections 321, 322, and 323 of Rule 8-1 limit general cleanup solvent emissions by requiring solvent to be stored in closed containers and cleaning to be done in a manner that minimizes emissions. Regulation 8, Rule 4 limits mass emissions from solvent and surface coating operations including surface preparation. Regulation 8-16 contains specific operating requirements for solvent cleaning equipment such as cold cleaners and vapor degreasers. Neither rule limits the VOC content or volatility of cleaning solvents. This measure would apply to all surface coating operations and would most likely require amendments to the general provisions of Regulation 8, Rule 1, and to each source specific rule in Regulation 8.

The South Coast AQMD has adopted a similar control measure directed at reducing emissions from cleanup solvents in their 1989 AQMP revision (CM 88-A-11).

Emissions Subject to Control

The affected source categories are the cleanup solvent categories for all types of surface coating operations including architectural and industrial maintenance coating, and the various manufacturing industries. It should be noted that there is considerable overlap between this control measure and several of the others proposed. The emissions projected for future years are based only on those requirements that have already been adopted, and do not consider the effects of any proposed control measures. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	18.9
2000	19.5
2003	20.1

Proposed Method of Control

This control measure would achieve precursor organic emission reductions by requiring the use of low VOC or lower vapor pressure cleaning solvents. The South Coast AQMD currently requires the use of low VOC cleanup solvents for several industries. These requirements specify the use of cleanup solvents which have a composite vapor pressure of 45 mm Hg or a VOC content of 200 grams per liter, or lower.

Preliminary analyses done by the South Coast AQMD indicate that existing solvent formulations could be used for other industrial cleaning applications.

In some instances, water-base solvent formulations can be substituted in place of conventional petroleum-base formulations. There are citrus-based, water-soluble cleaning agents in use that contain no volatile organic solvent. This control measure would encourage the use of these agents to the maximum extent possible.

Improved solvent handling procedures are also expected to reduce ROG emissions. There are no specific handling procedures outlined in this proposal.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. ROG emissions were assumed to be reduced by 40 to 60 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
Year	Low (TPD, Summer)	High (TPD, Summer)
1997	7.57	11.4
2000	7.81	11.7
2003	8.04	12.1

Costs of Controls

Some low VOC solvent formulations are currently available, but these products are generally more expensive than conventional formulations. Other solvents will need to be developed through research and development. The South Coast AQMD estimates the cost-effectiveness of low emissions cleanup solvent formulations to be \$1,100 per ton of ROG reduced.

Improved handling procedures reduce solvent usage, and therefore, should result in a cost savings.

Other Impacts

A reduction in hazardous waste generation may result if suitable substitutes for organic solvents are identified. There is a possibility of an increase in the emissions of substances which may be toxic or deplete upper atmospheric ozone if organic solvents are reformulated with non-precursor or "exempt" solvents. The District, however, may not allow these type of solvent substitutions.

References

South Coast Air Quality Management District, Substitute Solvents Used for Cleanup of Surface Coating, CM 88-A-11

revised, 8/21/97

CM A19: ULTRA-LOW VOC COATINGS

Background

This control measure would reduce ROG emissions from surface coating operations to "near-zero" levels by substitution of volatile organic solvents in coatings with oil produced from the plant *Vernonia Galamensis*. Vernonia oil is a naturally occurring, epoxidized oil, with great potential to be a solvent

substitute, reducing the VOC content of surface coatings to nearly zero. For some coating applications, radiation curable coatings, which also produce essentially zero ROG emissions, may be a more appropriate ultra-low VOC technology.

This control measure could be implemented into any surface coating rule of Regulation 8, as technology for that type of operation permits. The most likely surface coating regulations include Rule 3, Architectural Coatings; Rule 23, Flatwood Paneling and Wood Flat Stock; and Rule 32, Wood Furniture and Cabinet Coatings. Other surface coating regulations may be amenable to this measure if the technology is transferable.

Regulatory History

The District has traditionally implemented low VOC standards for coatings based upon projected (i.e. technology forcing) limits derived from knowledge of high solids and water based technology and with the cooperative efforts of coating formulators and resin manufacturers. These limits have been set according to the limitations and perceived needs of each substrate regulated, and altered to reflect availability of complying coatings. The existing limits of technology are as follows:

Architectural Coatings

General Limitation	250 g/l; current
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Specialty Limits:

Below Ground Wood Preserv.	350 g/l; 9/1/92
Clear Wood Lacquer	350 g/l; 9/1/92
Clear Wood Sanding Sealer	350 g/l; 9/1/92
Clear Wood Varnish	350 g/l; current
Graphic Arts Coatings	500 g/l; current
Opaque Stains	350 g/l; current
Opaque Wood Preservatives	350 g/l; current
Primers, Sealers, Undercoat.	350 g/l; current
Roof Coatings	300 g/l; current
Semi-transparent Stains	350 g/l; current
Semi-trans, Clr Wood Preserv.	350 g/l; current
Clear Shellac	730 g/l; current
Pigmented Shellac	550 g/l; current
Waterproofing Sealers	400 g/l; current

Wood Furniture and Cabinet Coatings

Current Technology:

Clear Topcoats	680 g/l
Sanding Sealer	680 g/l
Washcoat	740 g/l
Pigmented Coating	600 g/l
Semi-transparent Stain	800 g/l
Opaque Stain	570 g/l

Future Limits:

Clear Topcoats	275 g/l; 7/1/95
Sanding Sealer	275 g/l; 7/1/97
Washcoat	120 g/l; 7/1/95
Pigmented Coating	275 g/l; 7/1/95
Semi-transparent Stain	120 g/l; 7/1/97
Opaque Stain	240 g/l; 7/1/97

Emissions Subject to Control

The affected source categories were assumed to be the various solvent-based architectural coating categories, *wood furniture and cabinet coating*, and *flat wood paneling coating*. Cleanup solvent categories were not included, although the emissions from these categories may also be reduced by this control measure. The projected ROG emissions from the affected categories are listed below.

It should be noted that there may be significant overlap between this control measure and others being proposed. The emissions subject to control given below only incorporate the effectiveness of control measures already adopted. The emissions from some of the affected source categories are expected to decrease over time due to implementation of new control measures.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	17.42
2000	16.13
2003	17.05

Proposed Method of Control

This control measure is derived from the South Coast AQMD Technology Advancement Office's (TAO) S-15 Project, cosponsored by the Paint Research Associates, the State of Michigan and the U.S. Agency for International Development. It involves the substitution of photochemically reactive solvents in coatings with oil produced from the plant *Vernonia Galamensis*. Vernonia oil is a naturally occurring, epoxidized oil, with great potential to be a solvent substitute, reducing the VOC content of architectural and wood furniture coatings to nearly zero. The oil will reduce the VOC content of typical formulas based predominantly on the properties of linolenic or other fast drying, unsaturated acids, developing coatings with high solids, alkyd and epoxy ester formulations.

The S-15 project intends to compare drying times and viscosities of conventional paint formulations with Vernonia diluents. For instance, it is projected that nitrocellulose lacquer, currently containing 680 g/l VOC could have less than 100 g/l VOC if it substituted Vernonia oil. The potential for directly applying Vernonia oil for preparation of solvent-less coatings and different dryer systems is also being evaluated. Vernonia oil produces no VOC emissions. So far, all blends of Vernonia reactive diluents with saturated and unsaturated acids appear to be compatible with alkyds; these blends can produce homogeneous paint formulations and high quality coatings.

Radiation curable coatings are high solids formulations which contain little or no organic solvents. These coatings use ultraviolet or electron beam energy to initiate the reaction to form a polymer surface coating. Radiation curable coatings, because of their high viscosity and need for control of coating thickness, are most amenable to flat stock roll coatings applications. Improvements in engineering have also allowed the application of radiation curable coatings on a three-dimensional basis.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. Each of the categories of coatings listed above could be reduced to at least 100 g/l VOC. It was assumed that the ROG emissions from the affected categories would be reduced by 90 to 95 percent due to this control measure.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	15.68	16.55
2000	14.52	15.32
2003	15.34	16.20

Costs of Control

Vernonia is projected to have excellent potential for commercialization, however no cost data are available at this time. Future South Coast TAO projects may focus on new methods for growing *Vernonia Galamensis* in the United States and the development of more cost-effective methods of extracting oil from the seeds.

According to EPA, the applied cost of radiation curable coatings is only slightly higher than for conventional solvent coatings, for the same area of coverage. If the operating costs associated with abatement equipment for conventional coating systems are considered, a cost differential in favor of radiation curable materials may actually result.

Other Impacts

Should methods of growing Vernonia in the U.S. be developed, this could be a major cash crop requiring agriculture zoned land to cultivate, adding to already competing pressures for land use.

Radiation curable coating systems use 75 to 90 percent less energy than conventional thermal curing systems. Available data indicate that some monomer emissions would be present in the exhaust for processes using radiation curable coatings, although further study is needed to better define potential toxic air contaminant problems.

References

South Coast Air Quality Management District, Technology Advancement Office, Annual Report, August 1990.

Draft Evaluation of Radiation-Curable Coatings as a Technology for Reducing VOC Emissions from Surface Coating Operations, EPA Control Technology Center, January 1991.

revised, 8/21/97

CM A20 CONTROL OF EMISSIONS FROM POLYSTYRENE FOAM, POLYETHYLENE, AND POLYPROPYLENE MANUFACTURING OPERATIONS

Background

This control measure would reduce ROG emissions from polystyrene foam, polyethylene, and polypropylene manufacturing operations. Emissions from these operations can be controlled with add-on abatement equipment capable of achieving 90 percent capture efficiency and 95 percent destruction efficiency or use of a non-VOC blowing agents, other than trichlorofluoromethane (CFC-11) or dichlorodifluoromethane (CFC-12).

Polystyrene foam or expandable polystyrene manufacturing include items such as Styrofoam cups, food containers, packing materials, cushions, and thermal insulation products. In the manufacturing operation, a blowing agent is used, which generally consists of a VOC, a CFC, or methylene chloride. Most of the blowing agent escapes from the product to the atmosphere during the manufacturing and storage operations.

Polyethylene products are made from both low and high density polyethylene and include but are not limited to gas tanks, stadium seats, film sheets, spoons, forks, knives, shopping bags, trash cans, and blow molded bottles for bleaches, detergents, and milk. Polypropylene products include but are not limited to food bottles and containers, hot/cold insulated drink cups, packaging materials, boats, insulation, housewares, disposable plates, and toys.

Regulatory History

The District currently does not have a specific rule directed at reducing VOC emissions from polystyrene foam, polyethylene, or polypropylene manufacturing operations. These sources are subject to Regulation 8, Rule 2, Miscellaneous Operations.

Emissions Subject to Control

The affected source categories are polystyrene foam, polyethylene, and polypropylene manufacturing operations. The VOC emissions from these manufacturing operations are approximately 0.16 tons per day. Two-thirds of affected operations already have VOC controls on some of their equipment.

Proposed Method of Control

The primary control technique that can be used to reduce VOC emissions from polystyrene, polyethylene, and polypropylene manufacturing operations using a VOC blowing agent is the use of thermal or catalytic incinerators, or carbon adsorption systems. The control technique that can be used to reduce emissions from operations using CFCs or methylene chloride as a blowing agent is a well designed carbon adsorption unit. Manufacturing processes may require modification to allow the installation of VOC collection equipment to include ventilation hoods, ducting systems, and enclosure equipment to contain the emissions of VOCs. The use of incineration and carbon adsorption systems can achieve emission reductions of 95% or higher, based on experience with similar operations in the District and elsewhere.

Control techniques for VOC other than those mentioned above may also be proposed. Operators may elect to switch to other approved non-VOC blowing agents, which include halogenated CFCs, CO₂, nitrogen, and other inert gases.

Emission Reductions Expected

The types of abatement devices that are expected to be used for reducing VOC emissions typically have control efficiencies in excess of 95 percent. Approximately two-thirds of the affected operations already have VOC controls, therefore, emissions from affected sources are expected to be reduced by approximately 25 percent or 0.04 tons per day.

Costs of Controls

The costs of control depends on the size and nature of the operation and on the control methods used. For those facilities without existing control devices, the costs will include both a collection and vapor processing system. Using data obtained from White Horse Technology, the consultant for Marko Foam Products in Hayward, the control cost for one installation was estimated to be about \$500 per ton of VOC reduced. On average the cost of control for this measure is expected to be about \$2000 per ton of VOC reduced.

Other Impacts

Where VOC emissions are controlled by incinerators, an increase in natural gas consumption will occur. The use of thermal or catalytic incineration to control VOC emissions, may result in emissions of CO, NO_x, or other criteria air pollutants. There is also the possibility of minor increases in certain greenhouse gases (CO₂ and NO₂) due to combustion of organic compounds and the use of natural gas in thermal oxidation abatement devices.

Where carbon adsorption systems are used to control VOC emissions, the activated bed eventually becomes "spent" and must be re-activated or disposed of at a licensed treatment storage and disposal facility (TSDF). Disposal of spent carbon adsorption filters may negatively impact solid waste disposal sites due to increased quantities of wastes. Spent carbon needs to be replaced or regenerated every 5 to 10 years. Spent carbon that is regenerated by steam injection may result in traces of solvent in wastewater after the steam/solvent mixture has been processed. However, wastewater impacts will be insignificant if generators comply with federal, state and local regulations. The use of carbon adsorption could result in emissions of NO_x and CO from the combustion of natural gas to generate steam for stripping solvent from the carbon bed. There is also the possibility of minor increases in certain greenhouse gases (CO₂ and NO₂) due to combustion of natural gas to generate steam for stripping the carbon beds.

Positive impacts include product recovery and possibly decreased emissions of toxic air contaminants.

References

San Joaquin Valley Unified Air Pollution Control District, Preliminary Staff Report, Proposed Amendments to Rule 4682 (Polystyrene Foam, Polyethylene, and Polypropylene Manufacturing), April 6, 1994.

revised, 8/21/97

B. FUELS/ORGANIC LIQUIDS STORAGE AND DISTRIBUTION

CM B2: IMPROVED STORAGE OF ORGANIC LIQUIDS RULE

Parts (c) and (g) adopted January 20, 1993

Background

This measure would reduce ROG emissions from organic liquid storage tanks by setting more stringent requirements for certain fixed and floating roof tanks. The measure is primarily directed at tanks storing organic liquids at petroleum refineries, chemical plants and bulk distribution facilities.

ROG emissions from fixed roof tanks include both breathing and working losses. Breathing losses stem from vapor expansion and contraction which result from changes in temperature and barometric pressure. Working losses include the combined emissions from tank filling and emptying. External or internal floating roof tank emission sources may include rim seal, withdrawal, deck fitting, and deck seam losses.

This control measure would affect petroleum refining facilities, chemical manufacturing plants, and possibly some bulk transfer and storage facilities. Some other industries which consume or produce significant amounts of organic liquids may also be affected to some degree.

Regulatory History

The District regulates emissions from the storage of organic liquids under Regulation 8, Rule 5. Rule 8-5 was originally adopted in 1978 and has been amended a number of times, most recently in 1993. Presently, organic liquids with Reid vapor pressures greater than 0.5 psia are subject to this Rule.

The standards for storage tanks are dependent on tank size and the volatility of the material stored. All tanks less than 260 gallons capacity, and some grandfathered tanks less than 2000 gallons capacity are currently exempt from Rule 8-5. Tanks larger than 20,000 gallons capacity that store liquids with Reid vapor pressures greater than 1.5 psia must be equipped with a vapor loss control device. The same requirement is applicable for tanks larger than 40,000 gallons capacity that store liquids with Reid vapor pressures greater than 0.5 psia. The required vapor loss control device may consist of a floating roof tank which meets specified criteria, a vapor recovery system, or another device which provides equivalent emission reductions.

Rule 8-5 requires periodic inspections of floating roof tank seals. Some modest requirements also exist for the removal of tanks from service during tank cleaning and repairs. No tank color requirements currently exist in Rule 8-5.

Emissions Subject to Control

The affected source categories are *petroleum refinery cone roof* and *floating roof storage tanks*, *other organic compounds evaporation -- storage tanks*, and *bulk plant breathing and working losses*. Only a portion of the total emissions in each of these categories was considered subject to this control measure. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	7.16
2000	7.30
2003	7.34

Proposed Method of Control

A number of control options are being considered for further controlling emissions from storage tanks as listed below.

- (1) Require more liquids presently stored in cone roof tanks to be stored in floating roof tanks, or to be controlled by vapor recovery. This could be accomplished by lowering the tank size and/or vapor pressure cut-offs in Rule 8-5.
- (2) Lower or replace the existing small tank exemption with a throughput exemption. This would subject small tanks which have significant throughputs to control requirements.
- (3) Require floating roof tanks that fail to comply to undergo more frequent tank seal inspections. Consider increasing tank seal inspection frequencies for other tanks, as well.
- (4) Require floating roof tanks to use the best type of primary and secondary seal and to improve fitting designs.
- (5) Establish tank color requirements for certain large above ground storage tanks.
- (6) Require vapor recovery for certain new tanks. Presently, floating roof tanks are not allowed for tanks holding liquids with a Reid vapor pressure exceeding 11 psia. The vapor pressure cut-off for vapor recovery could be reduced to 4 psia, or another suitable value.
- (7) Require a compliance-based floating roof tank vapor recovery retrofit, whereby floating roof tanks receiving a specified number of violation notices would be required to be abated by vapor recovery within a specified timeframe.
- (8) Require control of tank cleaning emissions. This is going to be required in the South Coast under their Rule 1149 on tank degassing. The South Coast AQMD assumed either carbon adsorption, refrigeration, incineration, or other adsorption technique would be used, and estimated about 3000 pounds of ROG reduction per tank cleaning.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. The various controls are expected to be implemented over a period of several years. ROG emissions were assumed to ultimately be reduced by 50 to 60 percent from affected cone roof tanks, and by 30 to 40 percent from affected floating roof tanks.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	1.04	1.26
2000	1.07	1.30
2003	1.10	1.34

Costs of Controls

The average cost-effectiveness of the various control options listed above is estimated to be about \$2000 per ton reduced. A more detailed discussion of costs for some of the individual options is given below.

- (1) Converting a fixed roof to a floating roof tank is estimated to cost about \$125,000 for a 40,000 bbl tank. The cost-effectiveness of this measure is estimated to be roughly \$1300 per ton of ROG reduced.
- (2) The costs of replacing a seal with an improved version are assumed to average about \$45,000 per tank. There are no additional operation and maintenance costs, above those which are presently required. If the tank must be emptied and cleaned out first, this cost will be higher if not done concurrently with routine tank cleaning. The cost-effectiveness of this measure is estimated to be roughly \$500 per ton of ROG reduced.
- (3) The cost for installing vapor recovery on a 120,000 bbl floating roof tank is \$323,000 to convert to an internal floating roof tank plus perhaps an additional \$25,000 for a scrubbing system. The operating costs for the scrubber are should be about \$2000 per year. Any cost due to improved compliance with existing rules should not be an additional cost for tank users because it is an expense that they should already have. The cost-effectiveness for vapor recovery retrofits is estimated to be about \$3000 per ton reduced.
- (4) The South Coast AQMD estimates \$4,000 to \$20,000 per ton reduced for the cost of controlling tank degassing, depending on the tank size.

Other Impacts

This control measure will reduce odorous emissions and reduce the emissions of benzene, a toxic air contaminant. There will also be less product losses.

References

Staff Report for Proposed Rule 1149, October 23, 1987, SCAQMD.

Private communications between Harold Lips and Pacific Refining on tank seal costs, April 30, 1990.

Oil and Gas Journal, "Geodesic-Dome Tank Roof Cuts Water Contamination, Vapor Losses," A.E. Barrett, July 10, 1990.

OAQPS Control Cost Manual, PB90-169954, Jan, 90.

revised Aug. 21, 1997

CM B2(h): LOW EMITTING RETROFITS FOR SLOTTED GUIDE POLES

This section (h) added to CM B2, 1997

Background

Floating roofs are used to control evaporative emissions from the storage of organic liquids in large tanks. Of the fittings in a typical roof, the highest emission rate is from a slotted guide pole. Although standard floats with a gap of no more than 1.3 cm are required by District Regulation 8, Rule 5, air movement through the slots creates a pressure differential that draws reactive organic emissions from the tank. Retrofits are now available which significantly reduce emissions and can be installed on a tank while in service.

The guide pole helps to prevent the roof from rotating and, when slotted, can be used for tank gauging and liquid sampling. Accurate tank gauging may be especially important when there is a change of ownership of the contained liquid.

Regulatory History

The EPA New Source Performance Standard for floating roof storage tanks prohibits the use of uncontrolled slotted guide poles on large tanks storing volatile organic liquids such as gasoline. Several tank owners in EPA Region 9 have been cited for installing uncontrolled slotted guide poles and subsequently entered into agreements with the US EPA to install retrofits to reduce emissions not only from the tanks out of compliance but also to install retrofits to other tanks not subject to this New Source Performance Standard.

Emissions Subject to Control

The emissions are ROG and include benzene, a toxic air contaminant. The affected source category is: *petroleum product evaporation - refinery - storage tanks*. The emissions from this category are shown below. Odorous sulfur compounds in organic liquids, such as hydrogen sulfide, will also be subject to control.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	7.16
2000	7.30
2003	7.34

Proposed Method of Control

Tank vendors and others now offer retrofit kits which can be installed on a tank still in service to reduce fugitive emissions of ROG and sulfur compounds. Conversely, some tank owners could choose to use a solid guide pole rather than a slotted guide pole.

Emission Reductions Expected

The emission reductions from each tank that are expected from this control measure are estimated to be 100 lb ROG per day per tank based on a 10 mph wind and high vapor pressure gasoline. The total reduction is estimated to be at least 1,000 lb (0.5 Ton) ROG per day, 365,000 lb (182.5 Tons) of ROG per year, based on the number of uncontrolled tanks in the District, and accounting for variable vapor pressures of organic liquids stored.

Cost of Controls

Data generated from API (American Petroleum Institute) suggests that the products loss savings will offset the costs of slotted guide pole retrofit within 2 to 3 years. At a cost of \$6000 per tank to install and maintain, the cost of this control measure is estimated to be \$300 per Ton ROG reduced.

Other Impacts

No associated adverse environmental impacts have been identified for this control measure.

References

"CBI Slotted Guide Pole Fitting"; CBI; 8/19/94

Laverman, R.Y.; "Evaporative Loss from External Floating Roof Tanks"; CBI Technical Publication CBT-5536; 4/17/89

revised from workshop draft 5/30/97

CM B2 (i): TANK INERTING REQUIREMENTS

This section (i) added to CM B2, 1997

Background

The vapor space above organic liquid in fixed roof storage tanks is commonly filled with an oxygen-free gas, typically nitrogen, natural gas or refinery gas. This is referred to as inerting. Tanks are inerted for several reasons. One reason is to keep the mixture in the vapor space out of the explosive range. Another reason is to protect the purity of the stored product. Some tanks are inerted with a constant flow of gas, although slight. This practice encourages the release of ROG since the tank must vent the excess inerting gas. This control measure would prohibit the use of a constant flow of inerting gas into a tank unless the vapors carried with the excess gas are controlled AND tanks that are inerted are vapor tight.

Regulatory History

Although even small gasoline storage tanks are required to have pressure/vacuum relief valves and larger ones must have a vapor recovery system, inerting of very large tanks is not generally regulated by the District.

Emissions Subject to Control

The category of emissions that this control measure addresses is *petroleum product evaporation - refinery - storage tanks*. The emissions from this category are shown below. This control measure will reduce ROG emissions plus emissions of odorous sulfur compounds.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	7.16
2000	7.30
2003	7.34

Proposed Method of Control

This control measure would require the use of a back pressure regulator to maintain a positive pressure in the tank head space instead of a constant flow (purge) setup. Only enough inert gas would be needed to pressurize the headspace. In addition, the tank headspace must be maintained to be vapor tight. Hence,

vapor tight relief valves must be used and other tank fittings on the tank roof would need to be maintained to be vapor tight.

Emission Reductions Expected

The emission reductions expected from this control measure assume a leak rate of 0.1 cu ft per minute. This results in total reductions from this measure of 0.5 Tons ROG per day.

Cost of Controls

Cost of controls should be less than \$1,000 per tank retrofitted, but is dependent on the tank size and condition. Additional costs may be incurred from the need for additional piping, control devices and roof fittings.

Other Impacts

There have been no associated adverse environmental impacts associated with this control measure.

CM B5: LIMITATIONS ON MARINE VESSEL TANK PURGING

Background

This control measure would reduce ROG emissions from marine vessel housekeeping operations. Emissions from these sources could be reduced by control devices or, in some cases, by delaying these operations until the vessel is outside of a specified zone to ensure that the emissions would not have an impact on the District's air quality.

Meteorological conditions along the coast of the District are such that offshore emissions are carried onshore most of the time, particularly during the summer ozone season. A number of petroleum tank vessel operations result in the emissions of reactive organic gases. Stringent requirements already exist to control ROG emissions from marine vessel loading and lightering operations. The specific operations addressed by this control measure are housekeeping operations.

Housekeeping emissions result from altering the composition of gases contained within cargo tanks by tank washing, gas freeing, and/or purging. Shipping representatives have indicated that ships leaving the District routinely gas free their cargo holds.

Regulatory History

The District has adopted two rules to reduce ROG emissions from marine tank vessels. These rules limit emissions when tanks are being filled at a marine terminal, and when tanks are being filled during a lightering operation. The District currently does not have any specific requirements relating to marine vessel housekeeping operations.

The District has primary legal authority to regulate marine vessel emissions which affect onshore air quality. That authority is subject to limitation only if federal law specifically preempts the District, or if State or local regulations would result in a direct unconstitutional burden on interstate or international commerce.

The South Coast AQMD has adopted a control measure proposing to control housekeeping and ballasting emissions in their 1989 AQMP revision (CM 88-I-3).

Emissions Subject To Control

The affected source categories are *marine vessel cleaning and gas freeing*, and *ballasting*. The projected emissions subject to control are given below.

<i>Year</i>	<i>Emissions Subject to Control (TPD, Summer)</i>
1997	2.50
2000	2.57
2003	2.57

Proposed Method of Control

Emissions from housekeeping operations could be controlled by directing the vapors to control devices (e.g., refrigeration, absorption, adsorption, or incineration) on board the vessel or on shore mounted units, or by delaying these operations until the vessel is outside of a specified zone to ensure that the emissions would not have an impact on the District's air quality.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. It was assumed that this control measure would reduce affected emissions by 90 to 95 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	2.25	2.37
2000	2.31	2.44
2003	2.31	2.44

Costs of Control

The costs of control depend on a number of factors including the control methods used, the volatility of the prior cargo, the remaining cargo quantity, the size of the tank vessel, and the amount of time required to commute between regulated and unregulated boundaries.

Vessels employing on-board controls would incur little additional costs to control housekeeping emissions. Vessels able to tie up to on-shore controls may also be able to incur little additional costs, because most terminals will soon have on-shore control systems.

Vessels not employing controls, and opting to conduct housekeeping operations outside the California Coastal Region prior to returning to the District would likely incur abatement costs of up to \$4200 per ton of ROG reduced, according to the South Coast AQMD. Vessels not employing controls and opting to conduct housekeeping operations outside the California Coastal Region while enroute to Valdez and/or other ports of call would not incur additional costs, but would only have to hold the vapors a little while longer before purging.

Other Impacts

Where ROG emissions are controlled by incinerators, an increase in natural gas consumption will occur. The use of thermal or catalytic incineration to control ROG emissions, may result in emissions of CO, NO_x or other criteria air pollutants. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of organic compounds and the use of natural gas in the thermal oxidation abatement devices.

Where carbon adsorption systems are used to control ROG emissions, the activated bed eventually becomes "spent" and must be re-activated or disposed of at a licensed treatment storage and disposal facility (TSDF). Disposal of spent carbon adsorption filters may negatively impact solid waste disposal sites due to increased quantities of wastes. Spent carbon needs to be replaced or regenerated every 5 to 10 years. Spent carbon that is regenerated by injecting steam through the carbon bed may result in traces of solvent in wastewater after the steam/solvent mixture has been processed. However, wastewater impacts will be insignificant if generators comply with federal, State and local regulations.

The use of a carbon adsorption system could result in emissions of NO_x and CO from the combustion of natural gas to generate steam for stripping the solvent from the carbon bed. There is also the possibility of minor increases in certain of the greenhouse gases (CO_2 and NO_2) due to the combustion of natural gas to generate steam for the stripping the of the carbon beds.

A reduction in the emissions of benzene, a toxic air contaminant, will result from this control measure. Positive water quality impacts should also result to the extent that ballasting in cargo tanks is reduced.

References

SCAQMD 1989 AQMP Revision, CM 88-I-3.

revised, 8/21/97

CM B6: CONTROL OF EMISSIONS FROM CLEANING-UP ORGANIC LIQUIDS

Background

This control measure would reduce ROG emissions from vacuum trucks that clean up hydrocarbon spills, and from equipment that is used to clean out gasoline storage tanks, tank trucks, and railcars that previously handled gasoline or other organic liquids. Emissions from these operations can be controlled with portable carbon adsorption systems.

Liquid spills at industrial facilities or roadways are often cleaned up using a vacuum truck to suck up the liquid into the truck's storage tank. As the liquid fills the storage tank, organic vapors that are contained in the vapor space of the storage tank are displaced to the atmosphere.

A similar procedure is used to clean out storage tanks, truck tanks, and railcars that usually store organic liquids. Before doing repair work on a tank or when taking a tank out of service, all of the organic liquid must be removed from the tank. This is usually accomplished by washing the tank with water or some other cleaning solution. The used water or cleaning solution, along with organic contaminants, is then pumped from the tank to a mobile tank truck or some other cleaning device. The liquid phase material is handled using conventional wastewater treatment methods. However, the vapors that are displaced from the truck tanks are emitted to the atmosphere.

Regulatory History

The District currently does not have a specific rule directed at reducing the ROG emissions from cleanup vehicles or tank cleaning equipment. These sources are subject to Regulation 8, Rule 2, Miscellaneous Operations.

District Regulation 8, Rule 9, Vacuum Producing Systems, requires that the vents from vacuum producing systems at petroleum refineries and chemical plants be controlled, although a required control efficiency is not listed. Vacuum tank trucks are specifically exempted from Rule 8-9.

Emissions Subject to Control

The emissions subject to control for this control measure have not been quantified at this time.

Proposed Method of Control

This control measure proposes to reduce ROG emissions that are generated from organic liquid spills and tank cleanup operations. These organic vapors could be ducted from the cleanup tank vent opening to a control device such as a carbon adsorption system. The carbon system would have to be mounted on the truck or tank cleaning equipment because of the mobile nature of these operations. Carbon canisters could be used which are very portable. Drum-sized carbon canisters typically contain about 150 pounds of carbon. When spent, these canisters can be regenerated or disposed of, as economic factors dictate. The truck operator may require a VOA instrument to show that there is no breakthrough of the carbon during operation. ROG emissions could be reduced by 95 percent using a portable carbon adsorption system.

Emission Reductions Expected

The types of abatement devices that are expected to be used for reducing ROG emissions typically have control efficiencies in excess of 95 percent. Because the emissions subject to control have not yet been quantified, however, emission reduction estimates are currently not available.

Costs of Controls

The costs of control would depend on the type of organic materials being cleaned up, the frequency of spills, the quantity of liquid involved in the spill, and other factors. Costs were estimated assuming that drum sized carbon canisters would be mounted on the cleanup vehicle and when spent, the canisters would be disposed of, rather than regenerated. Cost estimates were calculated in accordance with the method outlined in an EPA Control Costs Manual. The costs of purchase, transportation and disposal, are estimated to be approximately \$800 for each canister used. Assuming that a 150 pound carbon canister can collect 25 percent of its weight in organic compounds, the cost-effectiveness of this control measure would be: $\$800 / [(150 \text{ pounds}) (0.25)/(2000 \text{ lb/ton})] = \$42,000$ per ton of ROG reduced. The costs of a regenerable system that is frequently used is expected to be far less.

Other Impacts

Where carbon adsorption systems are used to control ROG emissions, the activated bed eventually becomes "spent" and must be re-activated or disposed of at a licensed treatment storage and disposal facility (TSDF). Disposal of spent carbon adsorption filters may negatively impact solid waste disposal sites due to increased quantities of wastes. Spent carbon needs to be replaced or regenerated every 5 to 10 years. Spent carbon that is regenerated by injecting steam through the carbon bed may result in traces of solvent in wastewater after the steam/solvent mixture has been processed. However, wastewater impacts will be insignificant if generators comply with federal, State and local regulations.

Positive impacts of this control measure include a reduction in the emissions of benzene, a toxic air contaminant.

References

United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Control Costs Manual, Fourth Edition, January, 1990, No. PB90-169954.

CM B8: EMISSION REDUCTIONS FROM GASOLINE DISPENSING FACILITIES

For the 1997 CAP, this measure has been revised from the 1994 CAP

Background

This control measure would reduce reactive organic emissions from gasoline dispensing facilities (GDFs) by requiring modifications to some existing vapor recovery systems and to require that only

vapor recovery systems compatible with the federally-mandated Onboard Refueling Vapor Recovery (ORVR) systems on new cars be used. There are approximately 2,700 gasoline dispensing facilities in the Bay Area. The majority of these stations are equipped with Phase I vapor recovery control regulating transfer of gasoline into underground storage tanks and Phase II vapor recovery control on motor vehicle refueling operations.

Regulatory History

The District regulates organic emissions from GDFs under Regulation 8, Rule 7. The Air District adopted the first Phase II control measure in the country in 1973. In 1976, California Air Resources Board (CARB) preempted the field, requiring that all Phase I and Phase II systems be certified by CARB. The standards require installation of CARB certified vapor recovery equipment on gasoline storage tanks, associated piping, and gasoline dispensers. The vapor recovery systems control emissions from the filling of storage tanks, tank breathing emissions, and motor vehicle refueling. The systems typically direct the gasoline vapors produced during motor vehicle refueling into the underground storage tanks via the dual or coaxial hoses. During cargo tank bulk delivery to the underground tanks, the gasoline vapor is displaced into the cargo tank via the GDFs Phase I vapor coupler and a vapor recovery hose. The cargo tank then returns the vapors to the gasoline terminal or bulk plant for recovery.

The 1990 amendments to the Clean Air Act required the Environmental Protection Agency (EPA) to promulgate an onboard refueling vapor recovery (ORVR) rule [ref: Section 202(a)(6)]. On April 15, 1992, however, the EPA published a Federal Register notice announcing its intention not to implement a vehicle-based control for refueling emissions. A petition for review was filed in the U.S. Court of Appeals. It was ruled that the Clean Air Act established a mandatory requirement for EPA to proceed with an ORVR rule. A public hearing was held on June 21, 1993 and the final ORVR rule was promulgated on April 6, 1994 [ref: 59 Federal Register 16262]. In May of 1994 CARB published a technical paper stating that certain vacuum assist Phase II systems would be incompatible with some of the ORVR designs, resulting in additional emissions from the vent pipes of GDF storage tanks.

Emissions Subject to Control

The affected source category is *fuels distribution - gasoline filling stations*. The emissions subject to control for GDFs are shown below. This figure is based on a daily throughput of 8.5MM gallons and 95% control on Phase I and Phase II.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	5.83
2000	5.88
2003	5.93

Proposed Method of Control

The proposed method of control entails equipment modifications that will improve the efficiency of the existing vapor recovery equipment. Minor modifications include:

1. Replacement of remote vapor check valves that allow fugitive emissions from the nozzle and hose during idle nozzle periods.
2. Mandatory CARB-certified insertion interlock on every bellows-equipped nozzle so that gasoline flow occurs only upon compression of the bellows in the fill pipe. An equivalent mechanism will be evaluated for "bootless" nozzles
3. Elimination of dual-hose Phase II systems at all GDFs

4. Mandatory certified spill boxes on the underground tanks to prevent ground contamination from spilled gasoline after filling the tank.
5. Specifications for the minimum diameter of the vapor tubing between the Phase II riser and dispenser cabinet.
6. Require that only ORVR compatible Phase II systems be installed after a specified date.
7. Require that only vapor recovery systems that have been certified by CARB to meet the following performance specifications be installed after a specified date:
 - a) The emission factor for organic compounds shall not exceed 0.7 pounds/1,000 gallons dispensed. This standard shall apply to the total organic emissions from (1) the nozzle/fillpipe interface, (2) storage tank vent pipes, and (3) pressure-related fugitive emissions, and (4) idle-nozzle emissions.
 - b) The emission factor for spillage shall not exceed 0.42 pounds/1,000 gallons dispensed and the emission factor for pseudo-spillage shall not exceed a specified limit in pounds/1,000 gallons dispensed.
 - c) Requirement that only systems that have met the requirements of Section 7 above, without any maintenance being performed for the 90 days prior to the certification test be approved.
- 8) Requirement that all storage tank vent pipes, including those on GDF exempt from Phase II, be equipped with a CARB-certified P/V valve. This will maximize the emission reduction benefit of ORVR by eliminating the ingestion of air into the storage tank during vehicle refueling events.
- 9) Include an exemption from Phase II vapor recovery for those facilities where ≥ 90 percent of the dispensed gasoline is refueling of ORVR-equipped vehicles.

The proposed modifications are dependent upon actions by the U.S. Environmental Protection Agency (EPA) and proposals presently being considered by CARB. Decertification of one nozzle using the remote control valve is being evaluated by CARB.

Emission Reductions Expected

The emission reductions as a result of these requirements are probably less than 3 TPD. The requirements for ORVR compatibility will, however, prevent an estimated 30 percent increase in emissions from GDFs by the year 2004. Emission controls at gasoline service stations have already been estimated at 95% vapor recovery efficiency for Phase I and Phase II, with a discount factor for imperfect compliance. The use of efficiencies will become meaningless with the introduction of ORVR vehicles, since the ORVR fillpipe designs prohibit vapors from returning to the storage tank.

Costs of Control

The costs of this control measure would be minimal. The modifications required by these proposed changes are relatively inexpensive. Some could be implemented during routine equipment maintenance. The time frame for implementation affects the cost-effectiveness of the measure; the costs are lower if equipment is replaced "as required," rather than at a final implementation date. The time frame for retrofitting will be determined during the rulemaking process. The cost of ORVR compatibility may result in higher costs for equipment and components, since the developmental costs will be passed on to the GDF operators.

Based on assumptions that would need additional evaluation and verification, staff believes that the control cost for these measures would be less than \$1,000 per ton of ROG. Individual control costs for the individual proposals will be determined during the rule making process.

Other Impacts

No adverse environmental impacts should occur as a result of this control measure. Because gasoline contains benzene, there will be a concomitant reduction in public exposure to that toxic air contaminant. The use of certified spill boxes and any other measures that will reduce gasoline spills will result in an

additional safeguard against groundwater degradation.

References

BAAQMD Interoffice Memo from Ken Kunaniec to Judy Cutino, 1994.

CARB Technical Paper, Estimation of Emissions of Phase II and ORVR Vapor Recovery Systems, May 24, 1994.

revised, 8/21/97

C. REFINERY AND CHEMICAL PLANT PROCESSES

CM C1: IMPROVED PRESSURE RELIEF VALVES AT REFINERIES AND CHEMICAL PLANTS RULE

Background

This measure would reduce ROG emissions from pressure relief valves at chemical plants and refineries by requiring rupture disks with tell-tale indicators, or venting to an abatement device.

Pressure relief valves are automatic pressure relieving devices used on equipment handling organic compounds. These valves are actuated when upstream static pressure reaches a set-point, unsafe level.

This control measure would affect pressure relief valves at petroleum refineries and chemical manufacturing plants, but does not apply to P/V valves used on storage tanks.

Regulatory History

The District regulates the emissions of precursor organics from pressure relief valves at refineries and chemical plants under Regulation 8, Rule 28. Rule 8-28 contains standards for pressure relief valves that are found to be leaking with a portable hydrocarbon detector. The measured leak rate at which action must be taken is 10,000 ppm. If leaking, the relief valve leak must be minimized and the relief valve repaired at the next turnaround.

Presently, Rule 8-28 requires that relief valves be inspected quarterly, unless the valve is inaccessible and then it is to be inspected annually. Inspection requirements were not added to Rule 8-28 until 1989; most affected facilities went through their first round of inspections as this control measure was being written in 1990. Accurate compliance data since that time has been difficult to establish, because the sources of fugitive emissions often not easily accessible.

Emissions Subject to Control

The affected source category for refineries is *fugitives -- pressure relief valves*. For chemical plants, relief valve emissions are included within the category *fugitives (all mfg.) -- valves and flanges*. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.78
2000	0.78
2003	0.78

Proposed Method of Control

Relief valves can be prevented from leaking by venting to a control device, or by installing rupture disks ahead of the relief valve. The typical control device used is a flare, but other systems can be used. If a rupture disk is used, in order to be effective, it should include a tell-tale indicator so that the operator can determine if a rupture has occurred.

Lowering the level at which a leak is considered may increase the effectiveness of this control measure. EPA is proposing a level of 500 ppm for pressure relief valves at chemical plants with no decision yet on refineries. The South Coast AQMD now requires a leak level of 200 ppm. The South Coast AQMD estimates a leak level of 200 ppm would result in an 80 percent reduction from the present estimated emission levels for relief valves (the District, however, does not yet have the emissions data on relief valves in the Bay Area to confirm these emission reduction estimates). The District is considering the feasibility of a 100 ppm leak definition.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. ROG emissions were assumed to be reduced by 60 to 80 percent from the affected source categories.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	0.47	0.62
2000	0.47	0.62
2003	0.47	0.62

Costs of Controls

The costs of this control measure are not well defined because the number of leaking valves at the affected facilities is presently unclear. Installing a rupture disk is usually a lower cost than venting to a flare because of the additional cost of piping required for tying into the flare header. Also, as additional loads to the flare are made, flare capacity is consumed and, eventually, a new flare system may be required.

A cost of \$5000 per relief valve needing repair is believed to be typical. This cost estimate includes labor and design, and the addition of the rupture disk or the re-routing of the vent line. The overall cost-effectiveness of this control measure is estimated to be roughly \$10,000 per ton of ROG reduced.

Other Impacts

This control measure will reduce emissions of benzene, a toxic air contaminant, as well as lower the amount of odorous emissions. There will also be less product loss resulting in more efficient refinery and chemical plant operations.

Where ROG emissions are controlled by incineration, emissions of CO and NO_x may result. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of organic compounds and the use of fuels in the thermal oxidation abatement devices.

References

SCAQMD Staff Report for Proposed Rule 1173, May 17, 1989.

revised August 21, 1997

CM C3 (b): CONTROL OF FITTINGS AT REFINERIES AND CHEMICAL PLANTS

This section (b) added to CM C3, 1997; section (a) adopted, 1992

Background

This control measure would reduce ROG emissions from fittings at chemical plants and refineries by requiring improved gaskets or improved fitting design, and a more stringent inspection and maintenance program.

Flanges are the projecting rims of pipes or piping components that attach pipes or components together. Fugitive emissions from flanges can occur due to leaking gaskets. Other connectors include screwed fittings and other types of fittings such as sight glasses, gauge connections, vents, sample lines, and plugs. As with flanges, they can leak due to poorly sealing gaskets or loose connections.

Regulatory History

The District regulates organic emissions from valves and connectors at petroleum refinery complexes under Regulation 8, Rule 18. The emissions from valves and flanges at small chemical plants are regulated under Regulation 8, Rule 22. Control Measure C3, part of the 1991 CAP, adopted in 1992, provided for increased stringency of leak standards for valves and flanges. Rule 8-18 requires that, if the concentration of organics at a distance of one-centimeter or less from the equipment is greater than 100 ppm, the leak must be repaired immediately, or minimized and repaired by the next turnaround if the equipment is considered essential.

Presently, Rule 8-18 requires that accessible valves be inspected quarterly and inaccessible valves be inspected annually. There are also limits on how many valves can be awaiting repair. There are no periodic inspection requirements for flanges and other connectors. They are only required to be inspected after equipment is replaced. This control measure would require some type of periodic inspection of fittings.

Emissions Subject to Control

The affected source category for refineries is *fugitives -- valves and flanges*. For chemical plants, the affected emissions are included within the category *fugitives (all mfg.) -- valves and flanges*. The projected emissions subject to control are given below. These estimates represent emissions from leaking equipment that would need to be replaced or modified. The emissions are estimated to be:

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	6.04
2000	6.04
2003	6.04

Proposed Method of Control

Advances in technology have resulted in valves and flanges with reduced fugitive emissions as well as improved gaskets for flanges and better fitting designs. This control measure would require periodic

inspection of fittings that are not now subject to the regulation and either tightening of the leaking fittings to meet a standard or replacement with improved designs.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. Although a large emission reduction is obtained from each leaking component, only a small percentage of components leak. ROG emissions were assumed to be reduced by 70 to 95 percent per component, 25 percent of components were assumed to leak.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
Year	Low (TPD, Summer)	High (TPD, Summer)
1997	1.06	1.44
2000	1.06	1.44
2003	1.06	1.44

Costs of Controls

Most of the costs would be due to the cost of increased inspection. New components may be required in some cases. The costs are estimated to be about \$1000 per ton of ROG reduced.

Other Impacts

This control measures will reduce emissions of benzene, a toxic air contaminant, as well as lower the amount of odorous emissions. There will also be less product loss resulting in more efficient refinery and chemical plant operation. Also, less fugitive emissions may help lower the risk of fires. No adverse impacts associated with this control measure have been identified.

revised, 8/21/97

CM C4: IMPROVED PROCESS VESSEL DEPRESSURIZATION RULE

Background

This control measure would reduce ROG emissions from process vessel depressurization at petroleum refineries and chemical plants by improving depressurization standards and by establishing flare gas recovery system sizing requirements.

The evacuation of process units during shutdowns and turnarounds is potentially a significant source of ROG emissions. Typically, a process unit is shut down by depressurization into a fuel gas or vapor recovery system with further depressurization to nearly atmospheric pressure by venting to a flare system. Although emissions are substantially reduced in this manner, some residual organic compounds are emitted from the depressurized vessels and excess emissions also can occur from inadequately sized flare systems.

Regulatory History

The District regulates the emissions of precursor organics from process vessel depressurization at petroleum refineries and chemical plants under Regulation 8, Rule 10. This Rule was last modified in 1983. Rule 8-10 requires that pressure vessels be vented to a flare or control device until the vessel's pressure is less than 5 psig. There are no efficiency requirements on the flare or other control devices used during depressurization of the vessel.

Emissions Subject to Control

The affected source category is *fugitives -- vessel depressurization*. A portion of the emissions included in the category *flares and blowdown systems* are also assumed to be affected. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.14
2000	0.14
2003	0.14

Proposed Method of Control

This control measure proposes more stringent depressurization standards. A vapor recovery system, such as a regenerative carbon adsorption system, could be used for controlling ROG emissions from depressurized pressure vessels (depressurized to 5 psig, or less). There are also other control techniques that could be used effectively. The same types of controls that are used for degassing storage tanks could be used, including refrigeration, incineration, or certain types of scrubbing. A 95 percent control efficiency should be achievable.

For the flare system, the compressor for the flare gas recovery system should be sized to be able to handle 200 percent of the normal flow to the flare. This is so that the flare can adequately handle the additional flow from the depressurizing of vessels. Also, the compressor should not be at its maximum flow operation for more than two percent of the time. By sending less gas to the flare, there will be a reduction in ROG (and CO and NO_x) emissions. The increased flare gas recovery system would also help to lower flare emissions during other upsets. More research needs to be done to estimate emission reductions from an improved flare gas recovery system. At a minimum, 20 to 50 percent reductions should be achievable.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. Fugitive ROG emissions were assumed to be reduced by 90 to 95 percent for vessel depressurization. The ROG emissions from flaring associated with vessel depressurization were assumed to be reduced by 20 to 50 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	0.03	0.07
2000	0.03	0.07
2003	0.03	0.07

Costs of Controls

For depressurizing pressure vessels, a portable regenerative system which will allow for recovery of the vented organics should be feasible. This type of control should be affordable because the system can also be used when storage tanks are degassed. Using the EPA's OAQPS manual (page 4-40) and taking

no credit for the recovered organics, the annualized costs of a typical-size system is estimated to be \$140,000. These costs are for a fixed system which treats a continuous effluent stream and removes 432 tons of organics annually. Assuming that the portable system used for vessel depressurization would only be used 6 months per year, and would cost 50 percent more than a continuous system, the cost would be \$210,000 per year to remove 216 tons of organic per year. This results in a cost-effectiveness of about 1000 per ton of ROG reduced.

Cost estimates for improved flare gas recovery systems are not known at this time.

Other Impacts

These control measures will reduce emissions of benzene, a toxic air contaminant, as well as lower the amount of odorous emissions. There will also be less product loss resulting in more efficient plant operations.

Where carbon adsorption systems are used to control ROG emissions, the activated bed eventually becomes "spent" and must be re-activated or disposed of at a licensed treatment storage and disposal facility (TSDF). Disposal of spent carbon adsorption filters may negatively impact solid waste disposal sites due to increased quantities of wastes. Spent carbon needs to be replaced or regenerated every 5 to 10 years. Spent carbon that is regenerated by injecting steam through the carbon bed may result in traces of solvent in wastewater after the steam/solvent mixture has been processed. However, wastewater impacts will be insignificant if generators comply with federal, State and local regulations.

The use of a carbon adsorption system could result in emissions of NO_x and CO from the combustion of natural gas to generate steam for stripping the solvent from the carbon bed. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of natural gas to generate steam for the stripping the of the carbon beds.

References

OAQPS Control Cost Manual, EPA, Jan 90, PB90-16995.

Literature form Baron-Blakeslee and Westates Carbon, Inc.

revised, 8/21/97

CM C5: IMPROVED WASTEWATER (OIL-WATER) SEPARATORS RULE

Background

This control measure would reduce ROG emissions from certain non-municipal wastewater treatment sources including oil-water separators, dissolved air floatation (DAF) units, and drains and junction boxes, by requiring covers on small units and by requiring specified units to be vented to abatement devices. This measure would primarily affect refineries, and possibly some oil production fields and other facilities.

ROG emissions from wastewater treatment plants include fugitive VOCs and dissolved organic gases that evaporate from the surfaces of wastewater contained in open drains and wastewater separators. Treatment processes such as DAF units, which involve extensive contact of wastewater and air, also can have significant fugitive ROG emissions.

This measure addresses the control of emissions which occur at the initial wastewater treatment operations. Control Measure C6 includes proposed controls for secondary treatment units.

Regulatory History

The District regulates the emissions of precursor organics from wastewater (oil-water) separators under Regulation 8, Rule 8. This Rule was last modified on November 1, 1989. Presently, Rule 8-8 requires that oil-water separators, DAF units, and junction boxes be covered, but the vents do not need to be

controlled. Most of these requirements become effective August 4, 1991. Small wastewater separator systems with capacities under 200 gallons per day are not subject to these requirements.

The South Coast AQMD, in their 1989 AQMP revision, has proposed to remove the small-unit exemption from their wastewater separator rule (CM 88-B-3).

Emissions Subject to Control

The affected source category is *wastewater -- (oil-water) separators*. The projected emissions subject to control are given below.

<i>Year</i>	<i>Emissions Subject to Control (TPD, Summer)</i>
1997	3.77
2000	3.89
2003	3.89

Proposed Method of Control

One proposed control is to remove or lower the existing 200 gallon per day exemption, and require even small units to be covered. The solid covers that would be required are well known and widely used in the petrochemical industry.

Another proposed control is to require that the vents from specified covered units be controlled. This could be accomplished by venting the units to an existing combustion device such as a process heater. Alternatively, a separate control system such as an incinerator or carbon adsorber could be installed. These type of controls would be expected to result in ROG reductions of about 95 percent from affected sources.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. Fugitive ROG emissions were assumed to be reduced by 90 to 95 percent from affected sources.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

EMISSION REDUCTIONS		
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	3.02	3.20
2000	3.11	3.31
2003	3.11	3.31

Costs of Controls

It is estimated that a small wastewater separator system could be covered for less than \$1000. The costs for installing add-on controls to a refinery wastewater system have been estimated based on information available from EPA. The following costs assume units are already covered and that a new control device must be added (i.e. an existing system such as a process heater is not used). The costs listed below are for a two million gallon per day system. The typical refinery would require two of these systems.

<u>Units</u>	<u>Capital Cost</u>	<u>Operating Cost</u>
Drains and Junction Boxes	\$159,000	\$60,000/year
Oil-water Separator	\$100,000	\$46,000/year
DAF Unit	\$100,000	\$46,000/year

The system for drains and junction boxes is high because of the piping required. It would be possible to combine the three controls systems and lower the total costs.

The overall cost-effectiveness of this control measure is estimated to be about \$3000 per ton of ROG reduced.

Other Impacts

This control measure will reduce emissions of benzene, a toxic air contaminant, as well as lower the amount of odorous emissions. If the recovered product is recycled, these systems will reduce product losses.

Where ROG emissions are controlled by incineration, emissions of CO and NO_x may result. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of organic compounds and the use of fuels in the thermal oxidation abatement devices.

References

VOC Emissions from Petroleum Refinery Wastewater Systems Background Information for Proposed Standards, EPA, PB87-190336, Feb. 85.

revised, 8/21/97

CM C6: FURTHER CONTROL OF EMISSIONS FROM WASTEWATER TREATMENT AT REFINERIES

Background

This control measure would reduce ROG emissions from secondary wastewater treatment processes at refineries by requiring covers on wastewater processing equipment, by replacing wastewater ponds with covered tanks (or by controlling wastewater streams), and by requiring control of pond desludging operations.

ROG emissions from wastewater treatment plants include fugitive VOCs and dissolved organic gases that evaporate from the surfaces of wastewater contained in open drains, wastewater separators and ponds. Treatment processes such as aeration ponds and dissolved air flotation (DAF) units, which involve extensive contact of wastewater and air, also can have significant fugitive ROG emissions. Pond desludging is a periodic activity that results in evaporative hydrocarbon emissions.

This measure addresses the control of wastewater treatment plant emissions which occur downstream of the DAF units. Control Measure C7 includes proposed controls for the initial treatment steps which include the drains and junction boxes, oil-water separators, and the DAFs.

Regulatory History

The District regulates the emissions of precursor organics from wastewater separators, forebays, and air flotation units at petroleum refinery complexes under Regulation 8, Rule 8. This Rule was last modified on November 1, 1989. Presently, Rule 8-8 requires that oil-water separators, DAF units, and junction

boxes be covered, but does not require that the vents be controlled. The rest of the wastewater treatment process is currently not covered by District regulations.

In addition, Regulation 11, Rule 12 adopts by reference 40 CFR Part 61, Subpart FF -- National Emissions Standards for Benzene Emissions from Benzene Waste Operations. The standards in this Rule, adopted on July 18, 1990, also affects refinery wastewater operations.

Emissions Subject to Control

The affected source category is *refinery wastewater treatment facilities*. Some emissions included in the category *refinery wastewater separators* are also assumed to be affected. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.91
2000	0.85
2003	0.86

Proposed Method of Control

The controls proposed for wastewater treatment plants include the covering of wastewater processing and holding tanks. Emission reductions from these sources can be maximized by using floating roof tanks where feasible, or by venting covered or enclosed tanks to a suitable abatement device. It is assumed that most wastewater ponds will need to be replaced by large holding tanks. Controlling the wastewater stream may be allowed as an alternative to pond replacement. Fugitive VOCs from wastewater can be reduced by stripping and abating the wastewater stream before extensive contact with the atmosphere occurs. It is estimated that application of the controls proposed will result in fugitive VOC emission reductions from affected sources of 90 to 95 percent.

Controlling pond desludging will most likely involve treatment of sludge by incineration, although other technologies may be acceptable. This type of control has been previously specified as a BACT-level control in new/modified permits.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. ROG emissions were assumed to be reduced by 90 to 95 percent from affected sources.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

EMISSION REDUCTIONS		
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	0.82	0.86
2000	0.76	0.81
2003	0.77	0.82

Costs of Controls

The most significant costs are likely to be for installing the large tanks to replace the ponds. Assuming that the typical refinery has a wastewater flow of 4 million gallons per day and needs three days of residence time for treatment, three 4-million gallon tanks will be required (these tanks will need some type of air spurgers). The installed costs of these three tanks, including piping and vent controls is estimated to be about \$6,000,000.

The annual operating costs should be similar to existing costs; no additional operating costs are expected except for vent controls. The annual operating costs of vent controls are estimated to average roughly \$45,000 per system.

The costs for closing the ponds, and treating the sludge were not available. Desludging the ponds and leaving them open for emergency use may be acceptable.

The overall cost-effectiveness of this control measure was estimated to be about \$10,000 per ton of ROG reduced.

Other Impacts

This control measure will reduce emissions of benzene, a toxic air contaminant, as well as lower the amount of odorous emissions.

Where ROG emissions are controlled by incineration, emissions of CO and NO_x may result. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of organic compounds and the use of fuels in the thermal oxidation abatement devices.

References

I.V. Klumpar, S.T. Slavsky "Updated Cost Factors: Process Equipment," Chemical Engineering, page 73, July 22, 1985.

VOC Emissions from Petroleum Refinery Wastewater Systems Background Information for Proposed Standards, EPA, PB87-190336, Feb 85.

revised, 8/21/97

CM C7: CONTROL OF EMISSIONS FROM PETROLEUM REFINERY FLARES

Background

This control measure would reduce ROG and NO_x emissions from petroleum refinery flares. The measure would eliminate all routine flaring activity and would permit the operation of a flare solely as an emergency device. Emissions will be reduced largely by improved flare gas recovery systems. The control measure is also directed at improving the efficiency of combustion of waste gases, and improving flare monitoring.

Because the exhaust gases of existing flares are difficult to monitor, the flare has become one of the few sources at petroleum refineries that is not subject to regulations regarding minimization of usage, control device efficiency, or even monitoring. Data collected during intensive investigation of flare episodes has indicated that flare emissions can be substantially greater than emissions estimated using average emission factors, which are based on good operating combustion efficiency.

Regulatory History

The District currently does not have a specific rule directed at reducing the ROG emissions from petroleum refinery flares. There are no existing District limitations regarding the combustion efficiency of flares for organic compounds (or for any other pollutants).

Flares must comply with District Regulation 6 regarding plume opacity; although under actual operating conditions and sometimes during maximum releases from flares, exemptions from the opacity standards are granted for refinery upset or breakdown of equipment.

The South Coast AQMD has adopted a control measure in their 1989 AQMP revision directed at petroleum refinery flares (CM 88-B-12).

Emissions Subject to Control

The source category affected is *refinery flare and blowdown systems*. The projected ROG and NO_x emissions subject to control are given below. These emission estimates are based on average emission factors, which may substantially underestimate actual emissions. It should be noted that there may be some overlap between this control measure and CM C4, which is directed at reducing emissions from process vessel depressurization.

Emissions Subject To Control

<u>Year</u>	<u>ROG (TPD, Summer)</u>	<u>NO_x (TPD, Summer)</u>
1997	0.11	2.54
2000	0.10	2.30
2003	0.15	3.32

Proposed Method of Control

The main method of control would be to recover over 90 percent of the organic compounds which are currently diverted to flares, through the use of more effective flare gas recovery systems. In addition, elimination of conditions leading to upsets and breakdowns and improved design of equipment and operations should reduce the flow of gases to flares.

Improved design considerations, such as regulation of turndown, will also reduce emissions (e.g. cascading flare system -- water seals blown at inlets of the flare as throughput demand increases).

The majority of flaring activity could also be controlled by enclosed fireboxes, which would greatly improve combustion parameters. Finally, greatly improved monitoring, both upstream and downstream of the fireboxes, will result in more efficient operation.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. ROG emissions were assumed to be reduced by 70 to 80 percent from affected sources. NO_x emissions were assumed to be reduced by 30 to 40 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	ROG REDUCTIONS (SUMMER)		NO _x REDUCTIONS (SUMMER)	
	<i>Emissions Reduced</i>		<i>Emissions Reduced</i>	
<i>Year</i>	<i>Low (TPD)</i>	<i>High (TPD)</i>	<i>Low (TPD)</i>	<i>High (TPD)</i>
1997	0.08	0.09	0.76	1.02
2000	0.07	0.08	0.69	0.99
2003	0.10	0.12	1.00	1.33

Costs of Control

A rough estimate of the costs of this control measure is \$5 million per refinery, although no detailed cost estimates have been made. The cost-effectiveness of this control measure has not been quantified at this time.

Other Impacts

The control measure will result in fewer visible flames from flaring, as well as reduced emissions of CO and particulate matter. There may also be significant reductions in the emissions of odorous substances.

References

None.

revised, 8/21/97

CM C8: FURTHER CONTROL OF EMISSIONS FROM WASTEWATER PROCESS DRAINS AND SUMPS AT PETROLEUM REFINERIES AND LARGE INDUSTRIAL FACILITIES

Background

This control measure would reduce ROG emissions from process drains and sumps at petroleum refineries by requiring covers and/or venting of emissions to an abatement device, unless the concentration of ROG in the wastewater is below a certain level.

Sumps or catchbasins are generally described as a pit at the lowest point in a circulating or drainage system. Sumps may either be lined or unlined. They are used to receive, hold, and separate petroleum liquid and water mixtures, and can act as gravity separators.

Regulatory History

The District regulates the emissions of precursor organics from wastewater separators, forebays, air flotation units, and sludge dewatering units at petroleum refineries and large industrial complexes under Regulation 8, Rule 8. This rule was last modified on June 15, 1994. Presently, Rule 8-8 requires that oil-water separators, DAF units, and junction boxes be covered. Control Measures C5 and C6, require further control of wastewater operations by requiring further control of large oil-water separators, and dissolved air flotation units, requiring covers on wastewater treatment plants, and the elimination of sludge ponds. The rest of the wastewater operations, such as process drains, sumps, etc., are currently not covered by District regulations.

Emissions Subject to Control

The affected source category is *refinery process drains / wastewater operations*. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	3.86
2000	3.92
2003	3.93

Proposed Method of Control

The controls proposed for wastewater treatment operations include the covering of process drains and sumps, or replacement with a tank, or reduction of VOCs in wastewater by recycling or controlling emissions upstream of the drain or sump. Emission reductions from these sources can be maximized by covering or by venting covered or enclosed drains and sumps to a suitable control device. Fugitive VOCs from wastewater can be reduced by stripping and abating the wastewater stream before extensive contact with the atmosphere occurs. It is estimated that application of the controls proposed will result in fugitive VOC emission reductions from affected sources of 90 to 95 percent.

Covers for sumps and drains can either be fixed or floating. Fixed covers enclose the contained liquid without coming into contact with the liquid surface. A pressure-relief valve may be installed on the cover to allow for the variations of temperature and liquid level. Additionally, a vapor control system can be connected to the vent to reduce VOC emissions. Two types of floating covers are normally used for sumps - rigid and flexible floating covers. These covers float on the liquid and contact the liquid surface at all times.

As an alternative to covers, tanks can replace sumps or other components of the wastewater system. Tanks that replace sumps, etc., are equipped with fixed roof covers similar to tanks used at oil refineries. As the liquid level is maintained, pressure-vacuum relief valves installed at the roof vent will control the venting of organic vapors during normal operation. Emissions from the tank would be limited to leaking valves and breathing losses due to changes in temperature. A vapor recovery system connected to the vent can also control such losses. The system also minimizes leaks by eliminating pressure build-up inside the tank.

Emission Reductions Expected

Currently the Air District emission inventory for refinery process drains is about 2.2 tons per day of VOC. It is assumed that only half of the sources will be subject to control, based on exemptions and technical feasibility. Emission reduction estimates are based on the SCAQMD assumption that 90% of the emissions from each drain will be abated.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	1.74	1.81
2000	1.76	1.84
2003	1.77	1.85

Cost of Controls

The most significant costs are likely to be the installation of covers over process drains and sumps, or replacement of sumps with tanks. Cost estimates are taken from the SCAQMD staff report and are based on estimates developed by CARB.

Capital costs for covers and tanks for a variety of sumps ranged from \$28,000 to \$95,000 (1986 dollars), depending on the type of cover and cost of installation of a tank. The expected life cycle of the equipment ranges from 5 to 20 years. Average cost-effectiveness for all types of covers and/or tanks, weighted equally, was \$8500 per ton of VOC reduced.

Other Impacts

This control measure will reduce emissions of benzene, a toxic air contaminant, as well as lower the amount of odorous emissions.

Increased emissions of CO and NO_x may occur where VOC emissions are controlled by incineration. There is also the possibility of minor increases in the emissions of certain greenhouse gases (CO₂ and NO₂) due to the combustion of organic gases and the use of fuels in thermal oxidation abatement devices.

References

SCAQMD Staff Report for Proposed Rule 1176 - Sumps and Wastewater Separators, September 20, 1989.

SCAQMD Rule 1176 - Sumps and Wastewater Separators.

revised, 8/21/97

D. COMBUSTION OF FUELS

CM D5: CONTROL OF EMISSIONS FROM CEMENT PLANT KILNS

Background

This control measure would reduce NO_x emissions from Portland cement manufacturing plants by establishing NO_x standards for precalciner/kilns. This control measure would affect one plant, the Kaiser Permanente facility in Cupertino.

In 1977, a modernization program was begun at the Kaiser Permanente facility utilizing "state-of-the-art" technology for cement manufacturing. The modernized facility was completed and began operation in 1981. This cement manufacturing process is a relatively new type of dry process known as a four stage suspension preheater system. The precalciner/kiln used in this process is very effective in utilizing less fuel and maintaining lower NO_x levels per ton of cement produced than conventional kiln systems. This plant utilizes a special kiln burner and is designed to burn coal as a primary fuel and petroleum coke as a secondary fuel with natural gas as backup fuel.

The precalciner/kiln system differs from conventional methods in that the raw feed is approximately 85 percent calcined when it leaves the calciner and passes from the fourth stage into the kiln. About 60 percent of the fuel normally required in the clinkering process is used in the calcining reaction in the flash calciner. The remaining 40 percent of the fuel is provided to the rotary kiln as secondary combustion air for the final calcining and sintering reactions. In addition, heat from the hot clinker cooler is recovered and conveyed to the kiln as secondary air; a portion of the hot gases are ducted through a separate refractory-lined duct located parallel to the kiln and are combined with the hot combustion gases leaving the rotary kiln and sent to the calciner. This permits the fuel in the rotary kiln to be burned with preheated combustion air with minimum quantities of excess air (6-8 percent O₂), while maintaining optimum burning conditions in the kiln. When the proper balance of minimum excess air in the kiln and in the flash calciner is maintained, lower NO_x emissions are formed during the combustion process.

Regulatory History

Currently, the District does not specifically regulate NO_x emissions from existing cement plant kilns. The most stringent District requirements for kilns and other combustion sources are for new/modified units that are subject to the District's NSR Rule. Projects with NO_x emissions which exceed 150 lb/day or 25 TPY (cumulative increase) must meet stringent BACT requirements.

In 1981, CARB promulgated a Suggested Control Measure (SCM) for NO_x emissions from cement kilns. The South Coast AQMD adopted SCAQMD Rule 1112 which limited the emissions to 3.1 pounds of NO_x per ton of clinker; however, at no time was the objective limit achieved or even approached. As a result, the final emission limits were changed to 6.4 lb/ton of clinker produced when averaged over any 30 consecutive day period.

Emissions Subject to Control

The affected source categories are *other external combustion* for gas, coke and coal fuels. Only a portion of the total emissions in these categories are from cement kilns. The projected NO_x emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	6.67
2000	6.96
2003	7.29

Proposed Method of Control

The precalciner/kiln at the Kaiser Permanente facility currently meets the NO_x limits established in SCAQMD Rule 1112, as well as CARB's 1981 SCM, which were both intended for conventional cement kilns (existing emissions are about 1.8 pounds of NO_x per ton of clinker produced). Because the NO_x emissions from this source remain significant, District staff has evaluated a number of additional potential NO_x reduction methods that may be applicable to the precalciner/kiln. It is believed that promising post combustion control methods exist that could potentially provide NO_x reductions of 50 to 60 percent in a cost-effective manner, although these technologies have not been successfully demonstrated on cement kilns at this time. The following control technologies have been investigated and are summarized below:

(1) Selective Catalytic Reduction, (2) Thermal DeNO_x or Ammonia Injection, (3) Urea Injection and, (4) Cyanuric Acid Injection.

Selective Catalytic Reduction (SCR)

In this process, ammonia is injected into the hot flue gases in the presence of a catalyst to selectively reduce NO_x emissions. The catalysts allow the reaction to occur at temperatures between 550 and 800°F. District investigations reveal that SCR has not been successfully used in applications with a dust-laden gas stream. Pretreatment of the gas stream with some type of particulate removal device would therefore be required with a reheat system to adequately increase the temperature for the NO_x-reducing reaction to occur. Contamination of the catalyst bed is another unresolved problem. SCR is an unproven technology for this type of process and would probably have very high costs. Accordingly, this method is not considered a good candidate for implementation.

Ammonia and Urea Injection

Ammonia or urea injection technologies do not use a catalyst. These methods require optimum temperatures between 1400 and 1800°F. In order to meet these temperature requirements, gas stream reheating would likely be necessary. Ammonia or urea injection are therefore not believed to be good candidates for implementation.

Cyanuric Acid

This proposed NO_x control method is based on injecting isocyanic acid into the exhaust stream at temperatures above 750°F without a catalyst. Isocyanic acid is formed from the thermal decomposition of cyanuric acid, a non-toxic commercially available compound (when cyanuric acid is heated above

650°F, the compound breaks down to form isocyanic acid). Isocyanic acid can potentially remove NO_x from a variety of combustion equipment (e.g., the technology has been successfully demonstrated on the exhaust from a diesel engine). This process is considered the most promising post combustion process for reducing NO_x emissions from the Kaiser Permanente facility.

Emission Reductions Expected

In order to address uncertainty in the emission reductions that will result from implementing this control measure, low and high estimates were made. It was assumed that the average NO_x emission reductions from this control measure would be 50 to 60 percent.

The estimates below show the range of emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>Low (TPD, Summer)</i>	<i>High (TPD, Summer)</i>
1997	3.33	4.00
2000	3.48	4.18
2003	3.64	4.37

Costs of Control

A preliminary estimate of the costs of installing and operating a cyanuric acid injection system at the Kaiser Permanente precalciner/kiln were made. Capital costs considered included foundations, ducts, controls, piping and other direct facility costs including engineering design, supervision and fees, construction facilities, service facilities, initial charges and startup and performance tests.

The annual costs of the cyanuric acid injection system include raw material and operation and maintenance costs. The anticipated costs of control are listed below.

Capital Costs for Cyanuric Acid Injection

Equipment purchase costs	\$300,000
Accessory costs	100,000
Transportation and Sales Tax	25,000
Installation costs	200,000
Engineering cost (@ \$50/hr)	75,000
Contingency costs	<u>15,000</u>
Total capital costs	\$715,000

Raw Material costs	\$288,000
Electric power	36,000
Other utility costs	1,300
Maintenance cost (5% of equipment)	60,000
Operator costs (@ \$25/hr)	50,000
Engineer costs (@ \$50/hr)	100,000
Waste processing costs	<u>20,000</u>
Total annual operating costs	\$555,300

The cost-effectiveness of this control measure is estimated to be about \$2000 per ton of NO_x reduced.

Other Impacts

If cyanuric acid injection was used to control NO_x emissions, no significant adverse environmental impacts would be expected, except for a slight increase in CO emissions.

If SCR or ammonia injection control technologies were used, potential impacts from ammonia emissions would exist. Ammonia is a toxic compound and its production, use, storage, and transport can be hazardous. Worker or public health could be impacted in the event of an accidental release or spill. Low level operating emissions from "ammonia slip" are possible (up to 10 ppm), but would probably be insignificant. Some increase in truck traffic, and the associated vehicle emissions can be expected due to the delivery of raw ammonia.

The use of SCR could also adversely affect local water resources as a result of regenerating catalysts. For combustion equipment using fuels with a high sulfur content and having a high ammonia slip, the use of SCR for NO_x removal may cause ammonium bisulfate and/or ammonium sulfate deposits to form downstream from the unit reactor, producing plugging and corrosion. These deposits are usually removed from the SCR system using water or steam soot blowing techniques. Catalyst regeneration through washing would create wastewater requiring proper handling and treatment to avoid contamination of water resources.

References

South Coast AQMD Rule Development Division, Staff Report - Control of Oxide of Nitrogen from Cement Kilns, January 17, 1986.

"Rapid Reduction of Nitrogen Oxides in Exhaust Gas Streams," R.A. Perry and D.L. Siebers, Nature Vol. 324, December 1986.

South Coast AQMD Rule 1112: Emissions of Oxides of Nitrogen from Cement Kilns, Amended June 6, 1986.

revised, 8/21/97

E. OTHER INDUSTRIAL/COMMERCIAL PROCESSES

CM E1: CONTROL OF EMISSIONS FROM RUBBER PRODUCTS MANUFACTURING

Background

This control measure would reduce ROG emissions from rubber products manufacturing by requiring control of emissions from curing and molding processes and from cementing operations.

Natural and synthetic rubbers are polymeric materials possessing elastic properties. The commercially important rubbers are natural rubber and a considerable number of synthetics, such as styrene butadiene rubber (SBR), nitrile, butyl, neoprene, "stereo" rubbers, and polyurethanes. Currently, over half the synthetic rubber produced in the United States is used for manufacturing tires.

Synthetic rubbers are produced in either liquid (latex) or solid (crumb) form. A generalized synthetic rubber formulation and the functions performed by the ingredients is: (a) rubber (basic ingredient), (b) pigments (diluting, hardening, reinforcing), (c) softeners (aiding processing, plasticizing, solvent proofing), (d) vulcanization agents (cross-linking), (e) accelerators (accelerating cross-linking reaction), (f) activators (controlling vulcanization) and, (g) any of a number of ingredients performing special functions such as coloring, flexibility, and retarding deterioration.

ROG emissions from the synthetic rubber manufacturing process consist of emissions from reactors and blow-down tanks, and mixing and drying operations. Fugitive emissions also occur from molding and curing processes when vulcanized rubber products are taken out of curing ovens or presses. Such emissions probably consist of decomposition products of organic additives or reaction products formed

in the vulcanization process. Organic solvent-based cements are also widely used in rubber tire manufacturing and recapping operations.

There are currently no major rubber product manufacturing plants operating within the District. However, there are seven small tire recapping facilities and about seven specialty rubber product plants involved in the manufacturing of flexographic rollers, medical gloves, tubings, and wire insulations.

Regulatory History

At the present time, the District does not have a specific rule directed at reducing ROG emissions from rubber products manufacturing operations. District Regulation 8, Rule 21, limits ROG emissions from rubber tire manufacturing operations, but the Rule does not apply to tire recapping. No facilities within the District are currently subject to Rule 8-21. The various rubber products manufacturing operations located in the District are subject to the general requirements of Rules 8-2 and 8-4.

The South Coast AQMD has proposed stringent controls for rubber products manufacturing in their 1989 AQMP revision (CM 88-C-4).

Emissions Subject To Control

The affected source category is *rubber products manufacturing*. The projected ROG emissions from this category are listed below. This control measure would affect only a portion of the emissions within this category. Because the emissions from the affected sources have not yet been determined, the emissions subject to control are considered unknown.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	0.19
2000	0.19
2003	0.20

Proposed Method Of Control

The ROG emissions from tire recapping operations are largely associated with rubber cement adhesive application and curing operations. The adhesive is usually applied on the tire in a booth or in a vented station. To control the ROG emissions, the adhesive application area could be enclosed and vented to a control device such as an incinerator or a carbon adsorption system. The other option for reducing the ROG emissions would be to develop and use low-VOC adhesives. This measure could be implemented by removing the retread operations exemption from Rule 8-21.

The ROG emissions from miscellaneous rubber product manufacturing are more difficult to control due to the wide diversity of manufacturing process. Fugitive ROG emissions are expected to be most significant in the molding and curing processes. The fugitive emissions, both in particulate and gaseous form, can be reduced by means of pick-ups installed in proper locations. A control system consisting of an electrostatic precipitator (ESP) followed by a carbon adsorber could be used to reduce emissions from these sources. The ESP would serve as a pretreater to remove the particulates from the effluent to avoid plugging of the carbon bed.

Emission Reductions Expected

The types of abatement devices that are expected to be used for reducing ROG emissions from rubber products manufacturing operations typically have control efficiencies in excess of 90 percent. The overall emission reductions from fugitive sources would not be expected to exceed 80 percent due to collection system inefficiency. Because the emissions subject to control have not yet been accurately quantified, emission reduction estimates are currently not available.

Costs of Control

The South Coast AQMD has estimated the cost-effectiveness of their rubber products manufacturing control measure to be \$5600 per ton of ROG reduced. This figure is based on the cost of installing and operating a carbon adsorption system with an air inflow rate of 5000 cfm.

Other Impacts

In addition to controlling ROG emissions, this control measure should result in reductions in particulate matter emissions.

Where carbon adsorption systems are used to control ROG emissions, the activated bed eventually becomes "spent" and must be re-activated or disposed of at a licensed treatment storage and disposal facility (TSDF). Disposal of spent carbon adsorption filters may negatively impact solid waste disposal sites due to increased quantities of wastes. Spent carbon needs to be replaced or regenerated every 5 to 10 years. Spent carbon that is regenerated by injecting steam through the carbon bed may result in traces of solvent in wastewater after the steam/solvent mixture has been processed. However, wastewater impacts will be insignificant if generators comply with federal, State and local regulations.

The use of a carbon adsorption system could result in emissions of NO_x and CO from the combustion of natural gas to generate steam for stripping the solvent from the carbon bed. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of natural gas to generate steam for the stripping the of the carbon beds.

References

U.S. Environmental Protection Agency, EPA-600/2-77-023i, 1987.

The Encyclopedia of Chemistry, third edition, Hampel & Hawley.

revised, 8/21/97

CM E3: CONTROL OF EMISSIONS FROM COMMERCIAL CHARBROILING

Background

This control measure would reduce ROG emissions from commercial charbroiling operations by setting standards for these sources. The emissions of PM₁₀ would also be reduced. The primary method of control will be the installation of add-on exhaust controls. The replacement of conventional charbroilers with grooved griddles is another control option.

Charbroiling refers to the direct-firing method of cooking meat on a grated grill. Charbroilers consist of three principle components: (1) a grill, (2) a heating source and, (3) a high temperature radiant surface. ROG (and particulate matter, PM) emissions from charbroilers occur when grease from the cooking meat falls onto the heated radiant surface.

There are believed to be over one thousand full service and fast-food restaurants located within the District which use charbroilers to cook hamburger patties, chicken, steaks, and other foods.

Regulatory History

The District currently does not have a specific rule directed at reducing the ROG emissions from commercial charbroilers. Charbroilers must comply with District Regulations 6 and 7 regarding visible

emissions and odorous substances, respectively, and with Regulation 1 regarding public nuisance. Because of these requirements, some existing facilities employ abatement devices to reduce emissions, although the emissions from most charbroilers are essentially uncontrolled.

The South Coast AQMD has adopted a control measure directed at reducing the emissions from commercial charbroilers in their 1989 AQMP revision (CM 88-C-3).

Emissions Subject to Control

The affected source category is *other industrial/commercial -- cooking*. Eighty percent of the emissions in this category were assumed to be affected by this control measure. The projected emissions subject to control are given below.

<u>Year</u>	<u>Emissions Subject to Control (TPD, Summer)</u>
1997	1.29
2000	1.41
2003	1.46

Proposed Method of Control

The primary control option for reducing ROG emissions from commercial charbroiling operations is add-on exhaust controls. ROG control devices applicable to charbroilers include adsorbers and afterburners. In most cases, grease particle emissions need to be controlled upstream of the ROG control unit. This can be accomplished by grease extracting exhaust hoods (generally required to meet building and/or fire codes) and/or electrostatic precipitators (ESPs). Add-on control systems are available to reduce ROG emissions in excess of 90 percent. Significant reductions in PM₁₀ emissions would also occur due to the necessary control equipment.

In some cases, the use of grooved griddles may be an acceptable substitute for charbroiling. Grooved griddles impart a similar appearance and flavor on certain meats, and are believed to have much lower ROG and PM emissions than charbroilers.

Emission Reductions Expected

It was assumed that this control measure would reduce ROG emissions from affected sources by 90 percent.

The estimates below show the emission reductions achievable if the measure could be fully implemented in the corresponding year.

	EMISSION REDUCTIONS
<i>Year</i>	<i>(TPD, Summer)</i>
1997	1.16
2000	1.23
2003	1.31

Costs of Controls

The South Coast AQMD has estimated the cost-effectiveness of a charbroiler control system consisting of an efficient grease extractor, an ESP and an adsorption-filter system to be about \$25,000 per ton of ROG reduced.

Other Impacts

No significant adverse environmental impacts are expected as a result of this control measure. A reduction in particulate matter emissions and the emissions of odorous substances will result from this measure. Self-cleaning control systems should reduce fire hazards caused by grease build-up in the exhaust systems. Increased use of grooved griddles, which require less ventilation than charbroilers, would save on energy costs.

Where ROG emissions are controlled by incinerators, an increase in natural gas consumption will occur. The use of thermal or catalytic incineration to control ROG emissions, may result in emissions of CO, NO_x or other criteria air pollutants. There is also the possibility of minor increases in certain of the greenhouse gases (CO₂ and NO₂) due to the combustion of organic compounds and the use of natural gas in the thermal oxidation abatement devices.

Where carbon adsorption systems are used to control ROG emissions, the activated bed eventually becomes "spent" and must be re-activated or disposed of at a licensed treatment storage and disposal facility (TSDF). Disposal of spent carbon adsorption filters may negatively impact solid waste disposal sites due to increased quantities of wastes. Spent carbon needs to be replaced or regenerated every 5 to 10 years. Spent carbon that is regenerated by injecting steam through the carbon bed may result in traces of solvent in wastewater after the steam/solvent mixture has been processed. However, wastewater impacts will be insignificant if generators comply with federal, State and local regulations.

References

South Coast AQMD, 1989 AQMP Revision, CM 88-C-3.

revised, 8/21/97

F. OTHER STATIONARY SOURCE CONTROL MEASURES

CM F3 (b): FURTHER PROMOTION OF ENERGY EFFICIENCY

Part (a) implemented 1997; this section (b) added 1997.

Background

This control measure would encourage actions to improve energy efficiency within the District. By reducing energy demands, fossil fuel combustion will decrease and the resultant emissions of NO_x will be reduced. This measure does not involve modifying an existing rule regarding emission control standards for specific equipment. It relies instead on education and incentive approaches.

Energy needs and requirements in California society are ubiquitous: they are important elements in such varied products, functions and activities as personal and mass transit vehicles, residential ambient temperature control and lighting needs, industrial production operations and pollution abatement equipment. Consequently, the wide, general range of applicability of this control measure provides a multitude of specific possibilities to reduce energy use.

Regulatory History

Under the California Clean Air Act enacted by the State legislature, the Bay Area Air Quality Management District (BAAQMD) has authority to develop, adopt and enforce emission control regulations relating to attainment and maintenance of State ambient air quality standards. The Act also provides the Air District with authority to develop indirect source control programs.

State legislation currently provides for certain State agencies to have designated responsibilities to address California's energy needs and develop and implement energy efficiency standards. State legislation also has established the role of local air pollution control agencies in addressing the air quality problems in the parts of the State where they have jurisdiction.

The District established, last year, an Energy Efficiency Working Group, consisting of representatives of both trade and environmental organizations. Its function was to identify various energy efficiency incentive options and evaluate their general practicability. From this effort, a number of options were selected as possibly useful in promoting energy efficiency. Two workshops to educate decision-makers in the Bay Area commercial and industrial community were held in January 1997, in San Jose and San Francisco.

Emissions Subject to Control

This control measure would result in reduced NO_x and CO₂ emissions, as a result of reduced electricity demand. Energy efficiency improvements for specific industrial operations involving process changes might also reduce ROG emissions from evaporation of organic liquids or solvents.

Proposed Method of Control

This control measure would promote energy efficiency through outreach, training, and recognition. The District would develop partnerships with industry, cities and counties, federal and agencies, trade groups and environmental organizations.

Possible actions follow:

- Prepare information regarding energy efficiency for the District's Air Currents publication and for trade group publications such as those of the Bay Area Council (BAC), Pacific Industrial and Business Association (PIBA), Santa Clara Valley Manufacturing Group (SCVMG), the local chapters of the Building Owners and Managers Association (BOMA), the International Facility Management Association (IFMA), and the Pacific Conservation Center.
- Work with trade groups to develop information on energy efficiency for their own publications.
- Develop an energy efficiency component for the District's web page, including providing links to other major energy efficiency web sites that can provide more technical details.
- Develop a joint training program with local industry, the US Environmental Protection Agency, US Department of Energy, PG&E, California Energy Commission and others, to demonstrate the use of and recruit participants in Motor Master+, Green Lights, Energy Star Building, and other, already developed energy efficiency programs and tools.
- Cosponsor other seminars workshops and training programs to promote local energy efficiency efforts.
- Encourage cities and counties to develop energy efficiency standards for new projects.
- Develop a voluntary District "anti-pollution partners"-type program, similar to the existing "Clean Air Champions" with potential local publicity, public information messages and news releases, just as the federal Motor Challenge, Green Lights and Energy Star Buildings provide an opportunity for national publicity. Work to integrate energy efficiency components into existing environmental compliance recognition programs, such as Alameda County's Green Business Program.
- Set an example for Bay Area residences and businesses by participating in EPA's "Green Lights" and "Energy Star Buildings" programs.
- Develop guidelines or policies to integrate energy efficiency incentives into rule revisions, for example, by using the amount of production rather than the amount of raw material used as the basis for setting emission limits.

Emission Reductions Expected

The emission reductions for this control measure have not been quantified.

Costs of Control

The costs associated with this control measure have not been quantified. Some measures that might be implemented to improve energy efficiency will result in savings.

Other Impacts

CO₂ emissions will be reduced. No significant adverse impacts are expected.

References

"Energy Efficiency as a Coordinated Environmental and Energy Strategy, Draft Phase I Report: Defining the Issues and Problems," Joint Committee on Energy Regulation and the Environment, April, 1990, pp. ii-1, ii-2.

"Energy Working Group Report," Staff Draft, prepared around September, 1990.

"Indirect Source Control Program," Issue Paper # 5 (Draft, 'Bay Area '91 Clean Air Plan (CAP)', BAAQMD), October, 1990.

"Increasing Energy Efficiency to Improve Air Quality," Remarks to the California Legislature Joint Committee on Energy Regulation and the Environment," October 1, 1990.

"Planning the Management of Global Air Pollution Issues - A Strategy for Air Pollution Control Agency Action," Presentation at the Air and Waste Management Association's 82nd Annual Meeting, Paper 89-39.7, June, 1989.

"Clean Air Plan Control Measure F3 - Promotion of Energy Efficiency: Steps to Achieve the Goal", BAAQMD Staff Memo, October 9, 1996

CM F5: USE OF EMISSION REDUCTION CREDITS TO MITIGATE EXCESS EMISSIONS FROM VARIANCES OR AS A SETTLEMENT OPTION FOR VIOLATIONS

This measure added for 1997 CAP.

Background

This control measure would provide for a use of interchangeable emission reduction credits (IERC's) to either: 1) mitigate excess emissions that result from a variance; or, 2) be used, at the District's option, as partial or complete settlement of a violation of an emission limitation in a District rule. Existing District rules provide the mechanism for permitted sources to generate and bank permanent emission reduction credits (ERC's). State law provides the mechanism for both permitted and non-permitted sources to generate, bank and trade IERC's, which will not be permanent. Variances may be granted by the District's Hearing Board in circumstances where compliance or non-operation are not feasible without an unreasonable taking of property. Variances are only granted where excess emissions are minimized to the extent feasible, or shown to be not significant. Violations are subject to fine, and violators are required to seek variance relief or correct the violation. The emissions from violations are often not redressed, although the retirement of ERC's as settlement for a violation has precedent. This measure would allow the retirement of IERC's from the District's emissions bank to offset emission increases that would result from variances or violations. Under the Clean Air Act, EPA does not have to recognize state granted variances, as the provision to grant them at a District level is not contained in the California State Implementation Plan. There has been little precedence, however, in EPA having pursued violations of the SIP against sources under variance. For Title V facilities, EPA has indicated a willingness to consider variance relief if ERC's were retired either permanently or temporarily concurrently with the increase in emissions from a facility under variance. This control measure may provide a mechanism for Title V facilities to obtain a variance and avoid the specter of federal enforcement action.

Regulatory History

1996 Assembly Bill 1777 requires the District to provide a mechanism to allow interchangeable emission reduction credits, (IERC's) to be generated from sources such as vehicles and area sources. These IERC's can then be used, as per SB 456, to offset compliance with Best Available Retrofit Control Technology rules. Further, the California Health and Safety Code, Section 40714.5 requires the District to allow non-permitted sources to bank ERC's without requiring permits of those sources. District staff is currently working on compliance with AB 1777 and SB 456 through changes to the existing Regulation 2, Rule 4: Emissions Banking, and creation of a new rule, Regulation 2, Rule 9: Interchangeable Emission Reduction Credits. These changes could result in IERC's being available to offset emissions from variances or violations. Variances are addressed in the California Health and Safety Code. Although it is not permissible to require the use of offsetting emission reductions for variance relief, as per Section 42352 (a)(5), a petitioner for a variance must, "reduce excess emissions to the maximum extent feasible".

Emissions Subject to Control

All pollutants could potentially be subject to this control measure. In 1996, excess emissions from variances totaled nearly 30 Tons of organic emissions and 18 Tons of oxides of nitrogen. Emissions from violations are not quantified.

Proposed Method of Control

As the District complies with the requirements of 1777 and 456, the use of IERC's could be an option to minimize excess emissions from a variance or settle a violation. Because the IERC's may be used to delay or offset compliance with a District BARCT rule, the IERC's must be included in the District's emission inventory. If few IERC's were available, it may not be possible to use them to minimize excess emissions from variances; however, if there were so many that they were less expensive to purchase than a fine for an emission violation, allowing use of credits instead of paying fines would only result in a violator being able to compare costs and choose the least expensive. Therefore, the option would have to be in the best interest of both the violator or variance seeker and the District. It is important to note that California law does not allow the District to require the use of credits for approval of the variance, however, District staff may take a position of opposition to a variance unless IERC's were retired in an effort to minimize emissions from the facility to the maximum extent feasible. For Title V facilities, the EPA may allow a variance or refrain from taking enforcement action against facilities subject to Title V if equivalent ERC's or IERC's owned by the facility are retired, at least for the length of the variance period. This could be iterated in the District's Title V rule, which would then become part of the State Implementation Plan.

Cost of Controls

The cost of this control measure is tied to the cost of banked emissions. That cost of permanent ERC's is currently approximately \$6000 per Ton for either organic emissions or oxides of nitrogen. The amount and price of IERC's is not predictable, but, as long as the supply of automobiles that could be scrapped under the publicly funded program exceeds the demand for credits, price would remain at or below the price paid for car scrapping, currently about \$3000 per Ton of ROG and NOx combined. As 1777 and 456 become effective in the District, there would be greater opportunity to bank emissions, consequently the cost might go down. However, additional uses for banked emissions would tend to increase demand, driving the price up.

Other Impacts

There are no adverse environmental impacts associated with this measure. This measure would not generate local impacts, because the violation that increased air contaminants would have already occurred. Also, emissions from variances are already permitted by the District hearing board, pending findings that those emissions are minimized and would not interfere with attainment or maintenance of ambient air quality standards.

References

Lim, Kenneth and Stone, Greg; "Emissions Banking and Trading Regulatory Scoping Paper"; November 15, 1996

CAP staff workshop commentary, May 9, 1997

CAP public workshop commentary, May 20, 1997

revised from workshop draft, 7/23/97

CM F6: ENHANCED COMPLIANCE THROUGH PARAMETRIC MONITORING

This measure added for 1997 CAP.

Background

This control measure will provide for emissions reductions from various source categories by providing simple, inexpensive requirements for monitoring selected process variables that are reliable indicators or the parameters under which sources and abatement equipment must operate to stay in compliance. Many source categories are subject to annual testing requirements. Typically, these sources do not have continuous emission monitors that are required by federal or District regulation, or permit condition. Compliance, then, is really only determined by the annual source test. This control measure will use a source test to determine performance specifications which can define compliance with an emissions standard.

Compliance with these performance specifications, typically temperature, pressure, or flowrate, can be easily determined by visual inspections by plant personnel. This will provide industries with additional tools to maintain continuous compliance with a specific emissions standard.

Regulatory History

The District has a history of using source tests to establish compliance with emission standards. Typically, permit conditions or regulations require percent reduction efficiencies, the actual efficiency of an abatement device will fluctuate depending on type and amount of throughput, condition of the abatement device and environmental conditions. The historical source test procedure provides only a "snapshot" compliance picture.

Emissions Subject to Control

Although this type of control measure is directed toward ROG emissions, the principle applies to other pollutants. It is estimated that providing parametric methodology through source testing, that non-compliance rates could be reduced at by least one-third. This enhanced compliance rate will be reflected in the associated reduction in emissions.

Proposed Method of Control

A source test will be conducted to establish the dependent and independent performance specifications which define compliance with a specified emissions standard. These performance specifications will then be used as an additional tool for facilities to determine their compliance status. This control measure is

not intended to replace continuous emission monitors, but rather will apply to a class of facilities that do not have continuous monitoring requirements. Also, the EPA is promulgating guidelines for parametric monitoring, this control measure will interface with that effort.

Emission Reductions Expected

The emission reductions expected due to this measure have not been quantified.

Cost of Control

The costs associated with this measure will be the initial source test and the parametric monitoring equipment installed based on the results of the test. In addition, the District will incur some administrative costs in determining parameters appropriate for each source. However, it is anticipated that some savings to the affected facility and to the District will result from a reduced frequency of required source tests and a higher degree of continuous compliance. To the extent that additional recordkeeping may be required to log parametric indicators, there will be associated costs with that recordkeeping.

Other Impacts

No additional adverse environmental impacts are associated with this control measure have been identified.

CM F7: EASING OF ADMINISTRATIVE REQUIREMENTS FOR VOLUNTARY USE OF LOW EMITTING TECHNOLOGY

This measure added for 1997 CAP.

Background

This control measure will provide for a voluntary reduction in ROG emissions by easing administrative requirements such as daily record keeping for facilities that use substantially lower technology and certify that they continue to meet standards that emit less than the requirements in individual rules. Typically, rules preclude use of high emitting technology, but accommodate a range of technology, including that which is significantly lower emitting than the rule requires. However, the lower emitting technology may not be appropriate for all facilities in an industry or may have too great an economic impact to justify for an entire industry. As an example, many surface coating technologies exist that are water borne, but the coatings industry has long argued that such technology is inappropriate for all applications. Water borne coating applications exist in the auto refinish industry, the can and coil coating industry, the metal parts finishing industry, the wood coating industry and the industrial maintenance coatings industry, all of which have standards that accommodate higher emitting, solvent borne technology. Water borne coatings do not require organic solvent for use as diluent and often require little organic solvent for cleanup. Because water borne coatings are not able to be diluted so as to exceed rule limits, the need for daily recording of added thinner is largely unnecessary. In addition to other benefits, labor cost is saved by reducing administrative burdens such as record keeping, which may be substantial for a small business. This serves as an incentive to explore the application of technologies that go beyond the rule limits.

Regulatory History

The justification for this type of control measure is found in the EPA's Economic Incentive Program, or EIP, and the rules associated with establishing and taking State Implementation Plan (SIP) credit for EIPs. Although this CAP is directed toward the state ozone standard and is not the SIP, the same principles apply. The EIP rules stipulate that this kind of measure be credited as emission reductions occur, rather than as the rule is adopted, as with command and control measures. This type of incentive has already been adopted as an exemption in Regulation 8, Rule 32: Wood Products Coating. The exemption relieves the facility from maintaining daily records provided coatings used are less than 275

grams VOC/liter for high solids coatings and less than 100 grams VOC/liter for low solids coating. The facility must petition for this exemption and certify that these are the only coatings used.

Emissions Subject to Control

The category of emissions that this control measure addresses is: *Organic compounds evaporation - industrial and commercial coating*. The total ROG emissions from this category are 36.23 Tons ROG per day.

Proposed Method of Control

As iterated above, this could take the form of an exemption from record keeping or monitoring standards that a facility could voluntarily seek.

Emissions Reductions Expected

Although this is slated as an incentive to lower VOC emissions, it could be applicable to regulations for other pollutants, PM₁₀ or NO_x. As an estimate, if 10 percent of surface coating facilities may be able to implement lower VOC technology, reducing emissions from those facilities by up to 60%. This would result in a reactive organic emission reduction of 2.2 Tons/day

Cost of Control

There is a cost savings as a result of the implementation of this control measure. Typically, water borne coating formulations are, unlike solvent borne formulations, non-flammable. This results in significant savings in fire insurance costs and fire permit costs.

Other Impacts

No additional adverse environmental impacts associated with this control measure have been identified.

References

Martin, Karen; "Public Meeting and Public Information Document on Economic Incentive Program Rules"; US EPA; Sept. 17, 1991.

Parkinson, Rick. U.S. Cellulose Co., phone conversation, March 12, 1997.

US EPA. "Final Economic Incentive Program Rule", March 15, 1994.

CM F8: LIMITATIONS ON SOLVENTS BASED ON RELATIVE REACTIVITIES

This measure added for 1997 CAP.

Background

This control measure would consider limitations on solvents used in surface coatings or other evaporative solvent processes based on a reactivity scale of the solvents in addition to or in place of the already existing mass limitations. It is known that different organic solvent species react in the atmosphere not just at different rates, but form more or less ozone. EPA, in studying which compounds to list as "negligibly photochemically reactive", currently examines photochemical reactivity not just on the basis of reaction rates, but also on a Maximum Incremental Reactivity (MIR) scale, which measures the additional ozone formed when one additional compound is added to urban air. Although other atmospheric constituents such as particulate, NO_x and sulfates tend to affect the reactivity of reactive organic compounds, a review of recent literature indicates that the magnitude of differences between compounds outweighs the variability due to the pollutant mix in different airsheds. It should be noted that the US EPA considers compounds reactive or negligibly reactive for the purpose of ozone attainment plans. This determines whether the compound is to be controlled or to be exempt from control.

However, there exists a considerable range of reactivity in both compounds controlled and those exempt. For example, one gram of acetone (an exempt compound) will produce much more ozone than one gram of methyl siloxane (also exempt) but only slightly less than one gram of propane (a controlled compound). This differences would allow the District to amend its organic compound rules based on a consideration of photochemical reactivity rather than solely the mass emission limits that are currently prescribed.

Regulatory History

District regulations originally proscribed a solvent mix based on reactivities. Regulation 8, Rule 4, (originally Regulation 3) was based on South Coast AQMD's Rule 66, and allowed a maximum of 5% aldehydes and olefins, 8% aromatic compounds, and 20% ethylbenzene, branched ketones, trichloroethylene or toluene, and no more than 20% all these compounds combined. A source was allowed to emit 3000 lb VOC emissions/day if the solvent or surface coating complied with this formula, and only 40 lb/day if it did not. However, there was no limitation on the total mass of solvent per liter or gallon that could be emitted. Source specific rules, such as for can and coil coating, paper and film coating, and coating of automobiles, derived from the EPA's Control Technologies Guidelines, set standards in terms of mass VOC per volume of coating without regard to speciation (except for "exempt" compounds). More recent regulatory activity in California has reconsidered relative reactivity as a means of decreasing ozone formation. The California Air Resources Board already considers the relative reactivities of tailpipe emissions for alternate fueled vehicles and is currently proposing a way to implement flexibility in their consumer product regulations by allowing relative reactivities of compounds used in consumer products to be considered as long as the total ozone formed by the use of the product does not increase.

Emissions Subject to Control

VOC emissions from a variety of categories could be potentially subject to this control measure. Primarily, the categories affected are: *Organic compounds evaporation - adhesives and sealants, structures coating, and industrial and commercial coating*. Together, the emissions inventory attributes 76.5 Tons ROG per day to these categories. There are currently 20 District rules that control emissions from these categories. These rules regulate mass of organic compounds emitted per volume of coating used. Although to what extent coatings could further be limited by imposing restrictions on the types of solvents in use based on each solvent's relative reactivity is not known, the potential exists for decreased ozone formed without further restricting VOC mass.

Proposed Method of Control

This control measure could take one of two forms. In the first, implementation of a reactivity scale could allow industry flexibility to meet existing standards in a different way, possibly by reintroducing coating technology that could not be formulated to comply with mass VOC standards, if the solvents used for that technology could produce less ozone, even though at greater masses. The standard of a rule would change from a volatile organic content (VOC) limitation of X grams/liter to an ozone production limit determined from existing coating formulations. The coating could emit no more than Y (ozone value) per liter, regardless of the total mass of solvent present. Y would be equivalent to grams of each type of solvent times the reactivity for each type of solvent. The coating technology applicable to a specific rule could then be assessed as to the possibility of reducing the ozone value to some factor: Y-z, considering the specific organic compounds emitted by that industry.

The second form the control measure could take would still retain the element of flexibility, but could retain the mass limitations, supplemented by a VOC limitation of X grams/liter with a Y (ozone value) standard. As above, this would be based on a reactivity scale of compounds and existing, compliant coating formulations. Decreased ozone formation could be achieved by reducing the Y (ozone value) standard while retaining the X grams/liter standard.

To implement a reactivity scale, the relative reactivities of various compounds would have to be established. This would entail considerable work. In the coating field, Dr. Carter and Dr. Winer of U.C.

Riverside have done a considerable amount of work to evaluate commonly used solvents. One area that would have to be closely examined is that any reactivity scale used should be appropriate to the meteorology and pollutant mix of the Bay Area. It would be important not to adopt a scale where the uncertainties would outweigh any difference between compounds. In the literature supporting EPA's proposal to exempt acetone from control as a VOC, the MIR was determined experimentally with samples of the air from 17 urban environments. The San Francisco Bay Area air sample gave a result that showed the reactivity to be greater than for ethane, which is considered the standard by which other compounds are measured. However, the report speculated that the result was because of the large variability of ethane in the samples, which showed a very low reactivity in the Bay Area air sample. This is projected to be a long term measure based on the complexity of work involved to determine appropriate reactivity scales and then determine regulatory form and the technical viability of reductions.

Emission Reductions Expected

This is unknown at this time, and emissions reductions would have to be phrased in a different manner rather than Tons of ROG reduced. It could be no ROG reduced, but less ozone produced. Because of the large tonnage of emissions from this category, even a small percentage reduction would be significant.

Cost of Control

The cost of this control measure is not estimable at this time. If a proposal were to grant considerable flexibility, then it may save money for affected industry. However, if a reactivity scale were adopted that were appropriate for the pollutant mix and meteorology for the Bay Area, but inappropriate for other parts of the state or country, the cost of formulating coatings for specific areas would be prohibitively expensive. The cost would be proportional to the amount of restrictions imposed on the use of more reactive solvents, and the amount of money required to reformulate to other solvents.

Other Impacts

There are no adverse environmental impacts associated with this measure.

References

Bergen, Michelle; Russell, Armistead G. and Milford, Jana B.; "Quantification of Individual VOC Reactivity Using a Chemically Detailed, Three Dimensional Photochemical Model"; Environmental Science and Technology, Vol. 29, No 12, 3029-3037 July 13, 1995.

Berry, James, US EPA, phone conversation June 20, 1996.

Carter, William P.; Luo, Dongmin; Malkina, Irina, L.; Pirece, John A.; "An Experimental and Modeling Study of the Photochemical Ozone Reactivity of Acetone"; December 10, 1993.

Carter, William P.; "Development of Ozone Reactivity Scales for Volatile Organic Compounds"; Journal of the Air & Waste Management Association 44: 881-899; July, 1994.

Hough, Adrian M. and Derwent, Richard G.; "Computer Modeling Studies of the Distribution of Photochemical Ozone Production Between Different Hydrocarbons"; Atmospheric Environment Vol. 21, No 9, 2015-2033; February 24, 1987.

Russell, A., Milford, J., Bergin, M.S., McBride, S., McNair, L., Yang, Y., Stockwell, W.R., Croes, B., "Urban Ozone Control and Atmospheric Reactivity of Organic Gases"; Science, Vol. 269, 491-495; July 28, 1995.

Russell, Armistead G.; Georgia Institute of Technology, phone conversation June 20, 1996.

Shiroma, Genevieve; Vergara, Floyd; Milkey, Paul; Kasper, Lisa, et. al., California Air Resources Board working documents for the Consumer Products Working Groups and Reactivity Subgroup; 1996 and 1997, various dates.

CM F9: PROMOTION OF THE DEVELOPMENT AND USE OF HIGH ALBEDO (REFLECTING) MATERIALS FOR ROOFING AND ROAD SURFACES

This measure added for 1997 CAP.

Background

This control measure would encourage the development and use of high albedo roofing and road surface materials that would help lower ambient summertime temperatures in urban areas. The quality of these materials that makes them desirable is that they reflect more, and absorb less, solar energy than materials now used in comparable service. Currently, materials in use have been developed only to meet performance criteria for their applications. Many have low reflectivity, so that they absorb solar energy, which raises their temperatures significantly. Over a large urban area, the result is increased urban ambient temperatures (known as the "heat island" effect). This causes increased photochemical production of ozone. In addition, increased ambient summertime temperatures, as well as increased building surface temperatures, increases the electricity demand of air conditioning systems (see Control Measure F3, "Promotion of Energy Efficiency"). This causes additional fuel to be burned at fossil-fueled power plants to supply the additional electrical energy needed for cooling, and, consequently, the production of more NO_x. Higher ambient temperatures also causes increased evaporation of organic liquids and solvents.

There are multiple benefits to be gained by lowering summertime ambient temperatures through the use of high albedo materials, including energy efficiency improvements in building HVAC operations.

As Bay Area population and urbanization have increased, and are expected to increase through the years, the use of current materials in the future guarantees an increased "heat island" effect, along with its associated adverse impacts. Meteorological and air quality modeling work performed by the Lawrence Berkeley National Laboratory for the Los Angeles Basin has shown that cooler surfaces can lower ambient temperatures and reduce ozone levels. It is expected that modeling the impacts of lowered albedo in the Bay Area would also show such benefits. Thus, the Bay Area can gain from the use of materials that can help reverse this effect.

This control measure does not involve modifying an existing rule regarding emission control standards for specific equipment. Instead, it would rely on outreach to (1) appropriate trade organizations to encourage their members to develop and market materials to replace the existing, high albedo, ones now used; (2) distributors, contractors and the public, to educate them about the value of these new products; and (3) local government permitting agencies, to consider how to revise their rules and/or relevant ordinances to encourage, or require, the use of these materials for both new and replacement projects. In developing this outreach program, the District will examine potential water quality impacts of runoff from new, more reflective materials. The District will not recommend the use of any road or roofing materials which have been found to significantly contaminate runoff.

Regulatory History

There is no regulatory history for this control measure in the Bay Area. The South Coast Air Quality Management District has, in its recent Air Quality Management Plan revisions, included this measure (for 1994, CM #94MSC-03, for 1997, CM #97MSC-01). Under the California Clean Air Act enacted by the State legislature, the Bay Area Air Quality Management District (BAAQMD) has authority to develop indirect and are source control programs.

Emissions Subject to Control

This Control Measure would result in reduced NO_x emissions (as a result of reduced electricity demand) and reduced organic emissions (as a result of reduced evaporation due to lower ambient temperatures). In addition, emissions of CO₂ would be reduced.

Proposed Method of Control

The control measure envisioned could include a multi-agency/industry effort to encourage development and use of these products. In addition, cities and counties can undertake a variety of actions to promote the use of high albedo materials through revisions to local ordinances and codes.

Emission Reductions Expected

NO_x and organic emission reductions expected from this control measure have not been quantified.

Costs of Control

The costs associated with this control measure have not been quantified. Generally, costs would be recovered in time through reduced electricity costs. Ultimately, there could be a net savings from implementation of this control measure.

Other Impacts

This control measure may increase energy use in winter for space heating. Should high albedo materials not have comparable longevity to existing materials, there may be an decrease in water quality from material runoff.

References

Taha, H., "Modeling the Impacts of Large-Scale Albedo Changes on Ozone Air Quality in the South Coast Air Basin", *Atmospheric Environment*, Vol. 31, No. 11, pp. 1667-1676 (1997).

Taha, H., Konopacki, S., and Akbari, H., "Impacts of lowered urban air temperatures on precursor emission and ozone air quality". Submitted to *The Journal of the Air & Waste Management Association* (1996).

US Environmental Protection Agency, "Cooling Our Communities". A Guidebook on Tree Planting and Light-Colored Surfacing", January, 1992.

G. INTERMITTENT CONTROL MEASURES

CM G3: SEASONAL CONTROLS ON ORGANIC LIQUID TANK AND WASTEWATER SEPARATOR CLEANING, AND REFINERY SHUTDOWNS

This measure added for 1997 CAP.

Background

This control measure would promote the shifting of work from the ozone season to the non-ozone season, or provide options for control of emissions when work was necessary to be done in the ozone season. Applicable operations would include scheduled shutdown of refinery process units and cleaning of process tanks, oil-water separators and storage tanks. Often, to avoid odors and the associated complaints, refineries have traditionally scheduled major shutdowns in the winter months. In most cases, process vessel tanks are cleaned along with these shutdowns. Storage tanks, however, are cleaned throughout the year. All these activities tend to produce large amounts of reactive organic emissions in a short period of time. This control measure would prohibit these activities in the ozone season (June through mid October) unless they were controlled. This would be cost effective because, to the extent that shutdowns or cleaning could be scheduled for the off season, the number of tanks that would need control equipment would be minimized. Facilities subject to this control measure would also be able to obtain and retire temporary emission reduction credits to comply with this control measure.

Regulatory History

Seasonal controls have traditionally been used in regulating open burning, gasoline formulation and asphalt paving but not with stationary sources. The degassing that proceeds organic liquid storage tank cleaning is controlled, but the emissions from cleaning are not. Marine loading has been prohibited on predicted ozone excess days until standards requiring control came into effect. A rule allowing the banking and the use of emission reduction credits to offset temporary emissions is currently being drafted.

Emissions Subject to Control

This control measure would control emissions from organic compounds generated from the type of activities listed above. This concept could be expanded to other industries beside the oil refining and distribution business and to other pollutants, such as particulate matter. Storage tank cleaning may emit 0.5 ton ROG per tank.

Proposed Method of Control

The control method contemplated would allow high emitting activities to occur in the non-ozone season, but require controls in the ozone season. The District would assure that any required controls complied with OSHA requirements in order to assure worker safety. Tanks are currently degassed with portable emission abatement equipment before workmen can enter. This same equipment could be used, with modifications, in the cleaning process.

Emission Reductions Expected

NO_x and ROG emission reductions expected from this control measure have not been quantified.

Cost of Controls

Industry would likely reduce costs to achieve compliance by not having to operate abatement equipment all the time, or avoid those costs altogether by scheduling emitting activities during the non-ozone season. Seasonal abatement for new sources which have not previously been abated, would, of course, be an increased cost to industry, however the cost of that abatement would be less than if the control were imposed throughout the year.

Other Impacts

If controls are avoided due to scheduling, there may be a local impact as opposed to controlling emissions at all times, however, these are emissions that are not now controlled at any time during the year, so the impact is only in comparing winter to summer impacts after the control measure is implemented, not an impact of comparing controlled to uncontrolled emissions. Odors, if eliminated during part of the year, may become more noticeable during the remainder of the year by comparison. There may be some transportation impacts of hauling saturated carbon adsorption material to and from different sites.

M. MOBILE SOURCE MEASURES

CM M1: MOBILE SOURCE EMISSION REDUCTION CREDIT PROGRAMS

Background

This measure would reduce emissions of ROG, CO, NO_x and other mobile source pollutants. High-emitting vehicles would be replaced by lower emission vehicles. Some of the emission reductions would be made available as offset credits, but a portion would benefit ambient air quality.

Mobile Source Emission Reduction Credits (MSERC) expand upon existing emissions credit and banking programs in place for stationary sources. This control measure would establish procedures and methodology for the generation of credits from the reduction of mobile source emissions. As the activities by regulated facilities may result in the reduction of emissions beyond those required by law, the development of MSERC programs allows a regulated facility to earn MSERCs that can be deposited in the District's banking program. The credits in the banking program, as set forth in Regulation 2, are used by facilities to meet offset requirements established under Regulation 2, Rule 2, New Source Review. The District also allows credits generated from mobile source emission reductions to be used as an alternative means of compliance with Regulation 13, Rule 1, Trip Reduction Requirements for Large Employers (since dropped in response to 1995 legislation). The general ways in which a regulated facility can earn MSERCs include: exceeding the basic requirements of a rule, voluntarily meeting some of the requirements of a rule, and voluntarily implementing emission reduction programs that are not regulatory requirements.

Not all mobile source emission reductions qualify for MSERCs. The California Air Resources Board (CARB) has specified criteria that must be met for emission reductions to qualify as mobile source credits:

- The reduction must not be required by law or regulation, or otherwise assumed to occur as part of a regional air quality plan.
- The reduction must be real, and quantified to an acceptable degree of certainty.
- The mechanism used to obtain mobile source credits must be enforceable and legally binding.
- The life of the reduction must be reasonably established, and commensurate with the proposed use of the credit.

Regulatory History

District regulations currently allow the use of mobile source emission reduction credits only to offset emissions from new stationary sources. Until 1994, there were no specific regulations or procedures to govern the generation of these credits. In October 1994, the District adopted into its Manual of Procedures guidelines for the generation of credits through the scrapping of older motor vehicles. At the same time, the District incorporated by reference CARB guidelines for other ways of generating mobile source emission reduction credits, including low emission bus purchases, zero emission vehicles purchases, and alternative fuel retrofits for motor vehicles. Under the District procedures for vehicle scrapping and the incorporated CARB procedures, all credits for emission reductions are calculated in accordance with CARB methodology.

Emissions Subject to Control

The affected source categories are various types of mobile sources. Only a small portion of the emissions in these categories would be affected. As the measures are voluntary, the emissions subject to control cannot be determined at this time because the number of mobile sources that may participate is unknown.

Proposed Method of Control

This measure will be implemented through procedures in Volume VIII of the District's Manual of Procedures. The procedural requirements and emission reduction methodology for generating MSERCs will be defined for the following mobile source generation credit strategies:

- (a) Privately funded vehicle buy-back programs. (District procedures adopted)
- (b) Fleet purchases of zero-emission vehicles. (CARB procedures incorporated by reference.)
- (c) Retrofits of existing light, medium, and heavy-duty vehicles to low emission status (CARB procedures incorporated by reference).
- (d) Providing a program to remotely sense the tailpipe exhaust of automobiles and repair vehicles identified as gross emitters.

Vehicle buy back programs for emission reduction credits can now be implemented by private companies. These programs encourage owners of older model, high-emitting vehicles to voluntarily retire their vehicles earlier than they would normally do so. In 1995 and 1996, one such credit program was conducted in the Bay Area with the aim of complying with the District's trip reduction rule, though credits generated by the program were not used because the District dropped the rule. Since 1996, the District has also operated a publicly-funded vehicle buy back program which does not generate credits and serves purely to benefit the public (see CM M5, Appendix I).

Additional credit programs are still in the developmental stages. These measures are voluntary and provide flexibility to facilities in complying with emission reduction requirements. The organic gases and nitrogen oxides emission reduction credits would be issued to those facilities that comply with the procedures, recordkeeping, monitoring and certification requirements set forth in the Manual of Procedures for each control strategy.

Emissions Reduction Expected

Because these measures are voluntary, the actual emissions reduction cannot be calculated until the number of mobile sources for each program is determined. As an example, under the vehicle buy back program, staff has determined that removal of 1,000 vehicles per year for three years would result in the reduction of 48.6 tons of reactive organic compounds (ROG) per year and 15 tons of nitrogen oxides per year for three years. Because of the banking credits available to participants in the credit program, only twenty percent of these reductions would be realized.

Costs of Control

The cost-effectiveness of the MSERC programs will vary greatly depending on the type of program developed. However, the cost-effectiveness analysis may indicate either no cost or even actual savings because the MSERC program adopted by the facility may be in lieu of more costly programs.

Other Impacts

The environmental impacts due to activities under these procedures will vary depending upon the specific actions initiated. As an example, no additional adverse environmental impacts are expected as a result of the vehicle buy back program. The program is merely an acceleration of the existing scrapping process. The other strategies may generate adverse environmental impacts due to the use of alternative fuels.

References

Guidelines for the Generation and Use of Mobile Source Emission Reduction Credits. California Air Resources Board, February 1996.

CM M1: MOBILE SOURCE EMISSION REDUCTION CREDIT PROGRAMS **(e) Credits for Scrapping Lawn and Garden Equipment**

This section (e) added for the 1997 CAP

Background

This measure would involve the development of a credit procedure to award emission reduction credits for the voluntary scrapping of high-emitting lawn and garden equipment and their replacement with cleaner equipment.

Regulatory History

Generation of Credits. In 1994, the District adopted Manual of Procedures (MOP) Volume VIII, which provides guidelines for the generation of mobile source emission reduction credits (MSERCs). Although the MOP contains specific guidelines for the generation of credits through car scrapping programs, no procedures were included for other means of generating mobile source credits. However, the MOP does

allow the generation of credits through any means set forth by the California Air Resources Board in *Mobile Source Emission Reduction Credits: Guidelines for the Generation and Use of Mobile Source Emission Reduction Credits*. The ARB document, however, does not include a procedure for generating credits through scrapping lawn and garden equipment.

A prerequisite for the creation of credits by the early retirement of older equipment and its replacement with newer equipment is that the newer equipment must be cleaner. In 1992, the Air Resources Board adopted regulations for lawn and garden equipment. Under the regulations (California Code of Regulations, title 13, sections 2400 et seq.), all utility engines used in lawn and garden equipment sold in California are required to meet progressively stricter emission requirements, with first tier standards going into effect in 1995, and much stricter standards going into effect in 1999.

In 1996, the South Coast Air Quality Management District adopted a credit generation procedure for lawn and garden equipment. The procedure, found in SCAQMD Rule 1623, authorizes credits for the early replacement of high-emitting equipment by new equipment meeting the ARB standards.

Use of Credits. Under current District regulations, MSERCs may be used only to offset emissions from new sources of air pollution pursuant to District Regulation 2, Rule 2. However, because State law (see Health and Safety Code section 40920.6) now requires air districts to allow the use of emission reduction credits for compliance with stationary source rules, there are likely to be more opportunities for the use of MSERCs in the future.

Emissions Subject to Control

Bay Area lawn and garden equipment emits a summer average of about 12 tons of reactive organic gases per day. However, this measure is a voluntary measure. Emission reductions would depend upon the level of participation in the program. As a result, emission reductions have not been quantified for this measure.

Proposed Method of Control

This measure would be implemented if Bay Area organizations indicate an interest in sponsoring scrapping programs for lawn and garden equipment. The measure would be implemented through the adoption of a credit procedure to be added to Volume VIII of the District's Manual of Procedures. The procedure may resemble that found in SCAQMD Rule 1623.

Emission Reductions Expected

NO_x and organic emission reductions expected from this control measure have not been quantified.

References

Bay Area Air Quality Management District. 1992. *A Demonstration Program to Cut Lawnmower Emissions Through Consumer Rebates and Stationary Source Offsets*. Grant Proposal to EPA for FY 93 Section 105 Funds. San Francisco: BAAQMD.

South Coast Air Quality Management District. 1996. Rule 1623. Diamond Bar: SCAQMD.

CM M1: MOBILE SOURCE EMISSION REDUCTION CREDIT PROGRAMS **(f) Credits for Scrapping Recreational Boat Engines**

This section (f) added for the 1997 CAP

Background

This measure would involve the development of a credit procedure to award emission reduction credits for the voluntary scrapping of high-emitting recreational boat engines and their replacement with cleaner engines.

Regulatory History

Generation of Credits. In 1994, the District adopted Manual of Procedures (MOP) Volume VIII, which provides guidelines for the generation of mobile source emission reduction credits (MSERCs). Although the MOP contains specific guidelines for the generation of credits through car scrapping programs, no procedures were included for other means of generating mobile source credits. However, the MOP does allow the generation of credits through any means set forth by the California Air Resources Board in *Mobile Source Emission Reduction Credits: Guidelines for the Generation and Use of Mobile Source Emission Reduction Credits*. The ARB document, however, does not include a procedure for generating credits through scrapping recreational boat engines.

A prerequisite for the creation of credits by the early retirement of older equipment and its replacement with newer equipment is that the newer equipment must be cleaner. In 1996, the Environmental Protection Agency adopted exhaust emission standards for new spark ignition gasoline marine engines (see 61 Fed. Reg. 52088, October 4, 1996). The regulations impose progressively stricter emission standards on these engines, beginning with model year 1998. Some manufacturers introduced new clean engines in 1997.

Use of Credits. Under current District regulations, MSERCs may be used only to offset emissions from new sources of air pollution pursuant to District Regulation 2, Rule 2. However, because State law (see Health and Safety Code section 40920.6) now requires air districts to allow the use of emission reduction credits for compliance with stationary source rules, there are likely to be more opportunities for the use of MSERCs in the future.

Emissions Subject to Control

In its rulemaking, EPA found that recreational boat engines produced an average of 30% of the nonroad ROG emissions in many areas. Bay Area recreational boat engines emit a summer average of about 17 tons of reactive organic gases per day, with about 80% of the emissions coming from outboard motors. Because this measure is a voluntary measure, emission reductions would depend upon the level of participation in the program. As a result, emission reductions have not been quantified for this measure.

Proposed Method of Control

This measure would be implemented if Bay Area organizations indicate an interest in sponsoring scrapping programs for marine engines. The measure would be implemented through the adoption of a credit procedure to be added to Volume VIII of the District's Manual of Procedures.

Emission Reductions Expected

NO_x and organic emission reductions expected from this control measure have not been quantified.

References

South Coast Air Quality Management District. 1996. *Draft Appendix IV-A, CM #97MOF-07 Credits for the Replacement of Existing Pleasure Craft Engines with New Lower-polluting Engines, Draft 1997 Air Quality Management Plan*. Diamond Bar: SCAQMD.

U.S. Environmental Protection Agency. 1997. *Environmental Fact Sheet: Emission Standards for New Gasoline Marine Engines*. Prepared by the Office of Mobile Sources. Ann Arbor: USEPA.

CM M2: AIRPORT GROUND SUPPORT EQUIPMENT

Background

This control measure would reduce ROG and NO_x emissions from airport ground service equipment by requiring operators of the equipment to reduce emissions, either by conversion to alternative fueled equipment or operational modifications.

Ground support equipment (GSE) services aircraft while loading and unloading passengers and freight. GSE includes equipment such as baggage tractors, belt loaders, aircraft tugs, cargo moving equipment and assorted service vehicles (fuel trucks, food service trucks, etc.). Most GSE is owned and operated by the airlines.

Most GSE is considered off-road mobile source equipment and is currently exempt from state and federal emissions standards. The majority of GSE in use at Bay Area commercial airports is fueled by gasoline or diesel. Nearly all types of GSE are now available with engines powered by alternative fuels, usually compressed natural gas (CNG) or liquefied petroleum gas (LPG), or electricity. Compared to conventionally-fueled equipment, GSE powered by alternative fuels and electricity have higher capital costs and lower fuel and maintenance costs. There is currently some limited use of alternatively-fueled GSE at Bay Area airports.

Regulatory History

The South Coast AQMD's Draft 1994 Air Quality Management Plan includes a proposed control measure for commercial aviation as part of its control strategy. The control measure (CM 94FIP-08) proposes establishing an emissions bubble with declining emission rate targets for mobile emissions sources under the control of the airlines, primarily aircraft, GSE and other miscellaneous mobile sources. The individual airlines would decide how specifically to comply with the control measure's requirements; however it is anticipated that conversion to alternatively-fueled GSE would be a widely used strategy.

Emissions Subject to Control

The affected source categories are exhaust and evaporative emissions from light duty equipment used at commercial airports, such as baggage tractors and aircraft tugs.

The District currently does not calculate GSE emissions as a discrete emissions inventory category. Based on data from FIP technical support documents on South Coast and Sacramento airports, it is estimated that current GSE emissions from the three major Bay Area commercial airports are approximately 0.53 tpd ROG and 1.39 tpd NO_x.

Proposed Method of Control

The District would adopt a rule requiring operators of GSE to reduce emissions from the equipment. The rule could set emission reduction targets, expressed in terms such as allowable emissions per average aircraft operation or per million annual passengers. The emission reduction targets could be gradually reduced over time to allow phased implementation of emission reduction strategies. It is anticipated that most operators would comply by converting gasoline and diesel equipment to alternative fuels or electricity.

As an alternative to requiring GSE operators to meet emission reduction targets, the District could adopt a rule requiring phased conversion of GSE fleets to alternatively fueled equipment. Most types of GSE are now commercially available with engines powered by alternative fuels or electricity. Options for a practical implementation schedule would be examined as part of the District's rulemaking process. Under either of the regulatory approaches proposed above, GSE operators could implement alternative emission reduction strategies, such as operational modifications, in lieu of conversion to alternative fuels.

Emission Reductions Expected

An ARB report on emission reduction strategies at airports estimates that full conversion of GSE to CNG and electric would yield reductions of 80% ROG and 76% NO_x. Assuming the phased implementation indicated below at Bay Area airports, this control measure would result in the following emissions reductions. (The actual implementation schedule would be developed during the District's rulemaking process.)

Year	% GSE Converted to Alternative Fuels	Emission Reductions (tpd)	
		ROG	NO _x
1997	33	0.14	0.35
2000	67	0.28	0.71
2005	100	0.42	1.06

Costs of Control

The major capital costs associated with this measure are installation of alternative fuel fueling facilities and conversion of existing GSE to alternative fuels or purchase of dedicated alternative fueled equipment. Capital costs of alternatively-fueled and electric GSE are approximately 10% to 30% higher than for conventionally-fueled equipment. Fuel costs and maintenance costs are lower for alternative fuel and electric GSE, however, so a net savings is likely over the life of the equipment. The costs of installing a CNG or LPG fueling facility vary greatly, but are considered to be significant. San Francisco International Airport currently has alternative fuel fueling facilities, so the costs are assumed not to be prohibitive.

The overall cost-effectiveness of this measure has not been quantified.

Other Impacts

Increased use of alternative fuels will result in less gasoline and diesel use, thereby lessening the threat of leaks and spills and related contamination of soil and groundwater.

Increased use of alternative fuels will contribute towards reducing U.S. reliance on imported petroleum.

Replacement of gasoline and diesel powered equipment with CNG, LPG or electric equipment will result in lower fuel costs and lower maintenance costs for GSE operators.

CNG, LPG and electric GSE must be refueled or recharged more often than gasoline or diesel equipment. Electric recharging and "slow-fill" CNG refueling can take up to several hours. Equipment refueling/recharging schedules would have to be revised and monitored to avoid disruptions to operations.

Conversion of GSE to alternative fuels and electricity would increase market demand for alternative fuel technology and provide data on vehicle performance, thereby helping to advance an emerging technology.

References

Energy and Environmental Analysis, Inc. and K.T. Analytics, for the California Air Resources Board, Air Pollution Mitigation Measures for Airports and Associated Activity, May, 1994.

South Coast Air Quality Management District and Southern California Association of Governments, Draft 1994 Air Quality Management Plan, 1994.

South Coast Air Quality Management District and Southern California Association of Governments, Draft 1991 Air Quality Management Plan, 1991.

U.S. Environmental Protection Agency, California FIP Notice of Proposed Rulemaking, Technical Support Document: Civil and Military Aviation, March, 1994.

CM M3: GROUND POWER SYSTEMS AIRPORT TERMINALS

Background

This control measure would reduce ROG and NO_x emissions from aircraft auxiliary power units and ground service equipment by requiring installation of ground power systems and pre-conditioned air at airport terminal gates.

While parked at terminal gates, commercial aircraft require an electrical power source to operate on-board electrical systems. Ventilation also is needed to cool or heat the cabin. Electrical power and ventilation are usually supplied by either an on-board jet engine called an auxiliary power unit (APU) or mobile ground power units (GPU) mounted on ground service vehicles. APUs burn jet fuel, while GPUs burn either gasoline or diesel.

As an alternative to APU and GPU use, aircraft can draw electrical power and cooled or heated air from fixed systems at terminal gates. Fixed electrical systems supply power from the local electrical grid to aircraft, and convert the power from the type provided by the utility (60 hertz) to the type used by commercial aircraft (400 hertz).

Fixed air conditioning systems provide pre-conditioned air to the aircraft in lieu of an APU. Aircraft air conditioning systems are powered pneumatically by the APU, not electrically. If a terminal gate only supplies electrical power, the APU still must be operated to provide air conditioning to the aircraft. Therefore, providing both electrical power and pre-conditioned air to the aircraft offers the greatest potential to reduce use of and emissions from APUs and GPUs.

There are various types of ground power and ventilation systems, ranging from single centralized systems designed for an entire airport or terminal, to "point of use" systems provided at individual gates. The selection of the most appropriate system for a specific airport depends in large part on the facility's physical design and ability to accommodate the system.

Various airports throughout the U.S. have installed ground power and pre-conditioned air systems at terminal gates.

Regulatory History

The South Coast AQMD's Draft 1994 Air Quality Management Plan includes a proposed control measure for commercial aviation as part of its control strategy. The control measure (CM 94FIP-08) proposes establishing an emissions bubble with declining emission rate targets for mobile emissions sources under the control of the airlines, primarily aircraft, ground support equipment and other miscellaneous sources. The individual airlines would decide how specifically to comply with the control measure's requirements; however it is anticipated that provision of ground power and pre-conditioned air would be a widely used strategy.

Emissions Subject to Control

The affected source categories are exhaust and evaporative emissions from APUs and GPUs operated at commercial airports. The District currently does not calculate APU and GPU emissions as a separate emissions inventory category. Based on data from FIP technical support documents on South Coast and Sacramento airports, it is estimated that for the three major Bay Area airports current APU emissions are approximately 0.017 tons per day (tpd) ROG and 0.295 tpd NO_x, and GPU emissions are approximately 0.010 tpd ROG and 0.029 tpd NO_x.

Proposed Method of Control

The District would adopt a rule requiring the three major Bay Area commercial airports to install ground power systems and pre-conditioned air at all newly constructed terminal gates. Each commercial airport in the Bay Area plans to construct additional gates in the near future, resulting in over a 33% increase in the total number of passenger gates. Because the systems can be provided more cost-effectively when included in the original design of the facility, this new construction provides an excellent opportunity to

install ground power and pre-conditioned air systems. The rule could also require, as a longer term measure, retrofit installation of ground power and ventilation at existing terminal gates.

Emission Reductions Expected

An ARB report on emission reduction strategies at airports estimates that provision of ground power at all terminal gates would yield reductions of approximately 90% ROG and 76% NO_x. The combined effect of providing electrical power and pre-conditioned air was not estimated. While the combined effect of using both systems would likely be greater, the estimated emissions reductions are based on the figures for ground power only in order to provide a conservative estimate.

The planned terminal expansions at Bay Area airports will occur over a period of several years. San Francisco International Airport's plans are farthest along. For the purposes of this analysis it is assumed that San Francisco's new gates will be completed by 1997, and that the new gates planned for Oakland and San Jose will be completed by 2000. This schedule would result in emission reductions of 0.003 tpd ROG and 0.027 tpd NO_x by 1997, and 0.008 tpd ROG and 0.082 tpd NO_x by 2000. Full implementation of this measure at all new and existing gates, feasible by 2010, would result in reductions of 0.025 tpd ROG and 0.246 tpd NO_x.

Costs of Control

Installation of ground power and pre-conditioned air systems at terminal gates represents a significant capital investment. Pre-conditioned air systems generally have higher capital costs than electric power systems. The incremental cost of providing this equipment at newly constructed gates would be considerably less than that of retrofitting existing gates.

Once installed, ground power and pre-conditioned air systems result in significant savings in fuel and maintenance costs by reducing use of APUs and GPUs. The reduced fuel and maintenance costs would likely pay back the initial investment within several years. Numerous airports around the U.S. have installed or are installing ground power and air, indicating that these systems result in a net savings.

The overall cost-effectiveness of this measure has not been quantified.

Other Impacts

Use of ground power and pre-conditioned air will reduce fuel and maintenance costs for airlines serving Bay Area airports.

Reduced use of GPUs will contribute to improved safety at airports by reducing the number of ground support vehicles at gate areas and taxiways.

Reduced use of APUs and GPUs will contribute towards reducing U.S. reliance on imported petroleum.

References

Energy and Environmental Analysis, Inc. and K.T. Analytics Inc., for the California Air Resources Board, Air Pollution Mitigation Measures for Airports and Associated Activity, May, 1994.

South Coast Air Quality Management District and Southern California Association of Governments, Draft 1994 Air Quality Management Plan, 1994.

South Coast Air Quality Management District and Southern California Association of Governments, Draft 1991 Air Quality Management Plan, 1991.

U.S. Environmental Protection Agency, California FIP Notice of Proposed Rulemaking, Technical Support Document: Civil and Military Aviation, March, 1994.

CM M4: LOW EMISSION VEHICLE FLEET OPERATIONS

Revised from 1994 CAP

Background

The purpose of this measure is to encourage the introduction and use of electric vehicles and vehicles fueled by natural gas in commercial motor vehicle fleets operating in the Bay Area. Fleet vehicles' share of total Bay Area vehicle registrations is probably similar to that for Los Angeles, where survey data indicate that fleet vehicles constitute about 12 percent of vehicle registrations and that the majority of vehicles are operated by a small number of fleet operators.

Regulatory History

Vehicle Code section 28113 requires that, beginning in 1997, all new light-duty vehicles operated for compensation to transport passengers must be low-emission vehicles, as defined by ARB regulations. In 1998, all new medium-duty vehicles used in the same fashion are required to be low-emission vehicles. In addition, air districts are authorized to adopt regulations to enforce these requirements. Although gasoline-fueled vehicles may meet the definition of "low-emission vehicle" (see Health and Safety Code sections 39037.05 and 43800 and California Code of Regulations, title 13, section 1900 et seq.), Senate Bill 135 (Stats. 1991, Ch. 496), which added Vehicle Code section 28113, included findings that indicate the intent of the bill was to encourage the use of alternative fuel vehicles (AFVs) and electric vehicles (EVs).

In addition to the Vehicle Code provisions, the California Clean Air Act (in Health and Safety Code section 40919) requires air districts classified as serious nonattainment areas to adopt measures requiring the use of a significant number of low-emission vehicles by fleet operators.

Federal legislation requires Federal, state, and fuel provider fleets to acquire and use AFVs. Under the National Energy Policy Act of 1992 (EPACT), at least 33% of Federal purchases in 1997, 50% in 1998, and 75% in 1999 must be AFVs, although a Presidential Executive Order may require more purchases, depending on funding, total purchases necessary, and availability and cost of vehicles. In California, the EPACT requirements for state fleets, which are less stringent than the Federal requirements, have been modified by a Governor's Executive Order to parallel the Federal fleet requirements.

Under EPACT, the U.S. Department of Energy (DOE) must also determine whether to apply fleet requirements to private and municipal fleets. Although EPACT allows imposition of such requirements as early as 1999, DOE is more likely to follow a "late rule" scenario that would impose requirements beginning in 2002 or an incentive approach allowed by the statute. However, under legislation introduced in the 105th Congress (H.R. 970, the Natural Gas Vehicle Incentives Act of 1997), private and municipal fleet requirements would be dropped, and fuel provider and state mandates would end in 1999 and 2000 respectively, in exchange for substantial tax credits for natural gas vehicles and fueling infrastructure.

Emissions Subject to Control

The affected source categories are tailpipe and evaporative emission from *light duty passenger vehicles - catalytic*, and *light and medium duty trucks -- catalytic*. It is estimated that one percent of the total emissions from these categories would be affected by this control measure. The projected ROG and NO_x emissions subject to control are given below.

Emissions Subject to Control

<u>Year</u>	<u>ROG (TPD, Summer)</u>	<u>NO_x (TPD, Summer)</u>
1997	2.01	2.22
2000	1.64	1.90
2003	1.26	1.52

Proposed Method of Control

This control measure is intended to increase the share of natural gas vehicles (NGVs) and electric vehicles (EVs) in fleets operated for compensation to transport passengers. For this to be practical for fleet operators, vehicles with adequate range and performance must be available, fuel must be available, and costs must be reasonable. As of 1997, a number of automobile manufacturers have introduced or are introducing natural gas models with ranges approaching those for gasoline-fueled models. Fueling infrastructure is limited but increasing. If federal natural gas tax incentives are adopted, the rate of increase should accelerate substantially. The EV market is also entering a new phase in model years 1997 and 1998 with several OEMs offering EVs for sale or lease.

The District will continue to support efforts by local jurisdictions and others forming clean fuels coalitions, such as the Oakland/East Bay Clean Cities Coalition, the South Bay Clean Cities Coalition, the San Francisco/Peninsula Clean Cities Coalition, and the Redwood Empire Clean Air Vehicle Coalition, to promote the use of NGVs and EVs.

The District will enforce the requirements of Vehicle Code section 28113 when, with increasing availability of natural gas and electric vehicles and fueling and charging infrastructure, it becomes practical to do so. Enforcement may take the form of a rulemaking effort or it may be done through negotiation.

Emission Reductions Expected

Emission reductions would depend on the availability of infrastructure, the number of NGVs and EVs acquired, and many other variables. It was assumed that the tailpipe ROG emissions would be reduced by 25 percent for passenger vehicles and by 48 percent for light and medium duty trucks. Evaporative emissions from these vehicles were assumed to be reduced by 100 percent. NO_x emissions were assumed to be reduced by 33 percent.

	EMISSION REDUCTIONS	
<i>Year</i>	<i>ROG (TPD, Summer)</i>	<i>NO_x (TPD, Summer)</i>
1997	1.03	0.73
2000	0.89	0.63
2003	0.71	0.50

Due to a lack of data on the number and characteristics of vehicles in fleet operations within the Bay Area, this estimate can not be improved upon at this time. Additional research as part of the implementation of this measure will allow for an improved estimate of effectiveness.

Cost of Controls

The costs of this measure are dependent on many factors, such as the price of NGVs and EVs compared to conventional vehicles, purchase incentives available, maintenance and overhaul costs, and the costs of fueling infrastructure. However, given current and proposed Federal and California tax incentives and rebates for purchases of NGVs, a current price of about \$4000 for the OEM natural gas option on a vehicle, and savings of about \$0.40 per gallon equivalent on fuel, NGV purchases by fleet operators may result in net cost savings. Although OEMs will be offering EVs for sale or lease, there remain significant uncertainties regarding prices. As a result, cost-effectiveness for EV purchases cannot be quantified at this time.

Other Impacts

It would be necessary to minimize leaks and losses of natural gas during handling, as methane is 30 times more potent than CO₂ as a greenhouse gas.

Increased use of natural gas and electric vehicles would reduce U.S. dependency on imported petroleum.

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